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OF

CIVIL ENGINEERS

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1919

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Charles M. Spofford
President, Boston Society of Civil Engineers
1918–1919

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BOSTON SOCIETY OF CIVIL ENGINEERS

FOUNDED 1848

PROCEEDINGS

PAPERS IN THIS NUMBER.

"Sanitation in Emergency Shipyards." W. L. Stevenson.
"Auto Catch-basin Cleaning Truck." L. M. Hastings.
Memoir of Deceased Member.

Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

MINUTES OF MEETINGS.

BOSTON, December 18, 1918. — A regular meeting of the Boston Society of Civil Engineers was held this evening at Chipman Hall, Tremont Temple, and was called to order at 8 o'clock, by the President, Charles M. Spofford.

There were present 210 members and visitors.

The record of the last meeting was read and approved.

The President reported for the Board of Government the election to membership, in the grade of Member, of Messrs. Charles Anthony Calderara and Madison Walter Christie, and in the grade of Junior, the election of Mr. Edward Alden Freeman.

The President announced the death of Rufus M. Whittet, a member of the Society, which occurred on December 10, 1918, and by vote the President was requested to appoint a committee to prepare a memoir. The committee named consists of X. Henry Goodnough and John J. Van Valkenburgh.

An invitation was received from the Boston Section of the American Institute of Electrical Engineers, for members of the Society to attend a united meeting of that Section and the Illuminating Engineering Society, to be held in Chipman Hall on Tuesday evening, January 7, 1919, at which Mr. M. Luckiesh would speak on the subject, "The Principles of Camouflage for Land, Sea and Air." The invitation was accepted and notice of meeting ordered sent to members of the Society.

On motion of Mr. Ambrose, the thanks of the Society were voted to the W. F. Kearns Company and the Holbrook, Cabot & Rollins Corporation, for courtesies extended to members of the Society on the occasion of the excursion this afternoon to the Boston Army Supply Base and the Commonwealth Dry Dock at South Boston.

The literary exercises of the evening consisted of a very full description of the construction of the Boston Army Supply Base, now nearly completed at South Boston, lantern slides being freely used to illustrate the subject.

In the absence of Mr. Frederic H. Fay, of Fay, Spofford & Thorndike, supervising engineers of the work, who had been announced as the first speaker, President Spofford presented the first paper. Major Charles R. Gow, constructing quartermaster, U. S. A., followed with a very full description of the base as built; and Mr. William F. Kearns, of the W. F. Kearns Company, the general contractor for the work, gave a brief account of the part taken by his company in the construction of the base.

After a brief discussion the meeting was adjourned.

S. E. TINKHAM, *Secretary.*

BOSTON, December 4, 1918. — A regular meeting of the Sanitary Section of the Boston Society of Civil Engineers was held this evening in the Society's library.

The meeting was called to order at 8.15 P.M.

The reading of the records of the last meeting was omitted.

Mr. W. L. Stevenson, sanitary engineer of the Shipping Board, Emergency Fleet Corporation, addressed the meeting on

the "Sanitation of the Emergency Shipyards." Mr. Stevenson explained the methods adopted in obtaining the proper water supply, methods of sewage disposal, garbage collection and fly and mosquito suppression.

Mr. C. E. Turner, representative of the Department of Health and Sanitation, 1st District, United States Shipping Board, spoke on the same subjects and explained the methods used to enforce regulations. The talk was partially illustrated with lantern slides.

There were twenty-nine members and guests present.

The meeting adjourned at 10 P.M.

HENRY A. VARNEY, *Clerk.*

Previous to the meeting, twenty-three of the members and guests dined at the Engineers' Club.

APPLICATIONS FOR MEMBERSHIP.

[January 15, 1919.]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

Carter, Raymond H. A., Chestnut Hill, Mass. (Age 43, b. New York, N. Y.) Graduate of Princeton University, 1899, with degree of B.S., three out of four years having been devoted to civil engineering course. From November, 1899, to date, connected with Otis Elevator Co. in its manufacturing, engineering and sales branches; is at present manager of New England territory for this company. Refers to F. H. Fay, B. A. Rich, H. F. Sawtelle, C. M. Spofford and S. H. Thorndike.

Christenson, James Andreas, Southbridge, Mass. (Age 28, b. Cambridge, Mass.) Graduate of Lincoln Grammar School, Malden, Mass., 1905; took courses in architectural and mechanical drawing at Malden evening school, 1905, 1906, 1909, and in architectural drawing and mathematics at Boston Y. M. C. A., 1907–8. From June, 1905, to August, 1907, with C. W. Leatherbee Lumber Co., Boston, estimating and mill order dept.; from August, 1907, to May, 1910, rodman with city engr. of Malden; from May, 1910, to May, 1912, transitman, draftsman and assistant engr. with W. B. Foster, Hingham, Mass.; from May, 1912, to September, 1913, asst. engr. with J. A. Whittaker, Southbridge, Mass.; from September, 1913, to January, 1914, asst. field draftsman, line and grade revision, with Canadian Pacific Ry.; from January to September, 1914, field draftsman, line and grade revision, with Intercolonial Ry., Canada; from September, 1914, to September, 1915, rodman on construction with S. N. E. R. R. Corp'n, Palmer, Mass.; from September, 1915, to January, 1916, timekeeper, cost clerk and engr. with Fred T. Ley, Inc., Springfield, Mass.; from January, 1916, to September, 1918, town engr., Southbridge, and in private practice; from September, 1918, to January, 1919, private, 472d Engrs., U. S. A.; is now in private practice. Refers to H. W. Estey, W. B. Foster, A. C. Moore and B. A. Rich.

Hart, Linton, Brookline, Mass. (Age 26, b. Brooklyn, N. Y.) Manual Training High School of Brooklyn, N. Y., 1910; Cornell University, College of Civil Engineering, 1914. In 1912, with Public Service Comm. of New York City and on Elmsford siphon of Catskill Aqueduct; in 1913, with Pittsburgh Contr. Co. on Elmsford siphon of Catskill Aqueduct; in 1914 and 1915, with Raymond Concrete Pile Co. as draftsman, field engineer and superintendent on construction of concrete docks, buildings and shipways; in 1916, made special study for Johns-Manville Co. on concrete products; from 1917 to date, New England district manager for Raymond Concrete Pile Co. Refers to E. P. Bliss, C. R. Gow, C. T. Main, W. L. Miller, H. F. Sawtelle and C. M. Spofford.

Kenney, Thomas Bartholomew, Roxbury, Mass. (Age 28, b. Boston, Mass.) Graduate of Northeastern College School of Engineering, 1918, civil engineering course. From June, 1911, to September, 1917, with Sewer Service, Public Works Dept., Boston, as rodman, transitman and in charge of party successively; from September, 1917, to date, transitman with Boston Street Laying-Out Dept. Refers to W. H. Bacon, J. W. Howard, D. P. Kelley, C. H. Restall, L. J. St. Amand and F. O. Whitney.

ROLL OF HONOR.*

ADDITIONS.

Cowles, Martin W. Lieutenant, Mill Plain Road, Suffield, Conn.
†Gillett, Laurence A. E. O. T. S.
†Horton, Freeman H. E. O. T. S.
Putnam, Harold W. Private, Co. B, 164th Infantry, A. P. O. 727, Am. Ex. Force, France.

REVISIONS.

Bresth, Alexander. 1st Lieutenant, Sanitary Corps, Camp San. Engr., care Camp Surgeon, Camp Joseph E. Johnston, Fla.
DeMerritt, Robert E. 1st Lieutenant, 27th Artillery, C. A. C., Camp Eustis, Va.
French, Charles A. Captain, Q. M. C., Officer in charge of Utilities, U. S. A., General Hospital No. 19, Azalea, N. C.
Johnson, George A. Lieutenant-Colonel, Q. M. C., Construction Div. of Army, 7th and B Sts., S. W., Washington, D. C.
Kendall, Theodore R. 1st Lieutenant, Sanitary Corps, U. S. A., 154 Nassau St., New York, N. Y.
Luther, Howard B. Lieutenant (j. g.), U. S. N. R. F., Bureau of Construction and Repairs, Navy Dept., Washington, D. C.
Newman, Rolf R. Captain, Engrs., U. S. A., Co. 1, E. O. T. S., Camp Humphreys, Va.
Osborn, John F. Major, 101st Engrs., A. P. O. 709, Am. Ex. Force, France.
Waring, Charles T. Major, Aviation General Supply Depot, Fairfield, Ohio.
Webb, DeWitt C. Commander, Civil Engr. Corps, U. S. N., Public Works Dept., U. S. Navy Yard, Charleston, S. C.
Wentworth, John P. Captain, Sanitary Corps, U. S. A., Camp San. Engr., Camp Bragg, Fayetteville, N. C.

LIST OF MEMBERS.

ADDITIONS.

Christie, Madison W. .... 24 Greenville St., Somerville, Mass.
Farwell, Carroll A.,
Care Fay, Spofford & Thorndike, 308 Boylston St., Boston, Mass.
Freeman, Edward A. .... 541 Ward St., Newton Centre, Mass.

* Members who are in the service and have not yet reported that fact to the Secretary are earnestly requested to do so, stating branch of service, rank and military address.

† Recently received honorable discharge from service on account of armistice.

CHANGES OF ADDRESS.

BURRILL, NATHAN C.,
Care H. P. Converse & Co., Naval Operating Base, Norfolk, Va.
CUTTING, GEORGE C., Care Atlantic Corp'n, Shipbuilders, Portsmouth, N. H.
LEAVITT, ALBERT J. . . . . 16 High St., Southbridge, Mass.
MILLER, CHARLES A. . . . . 430 Harvard St., Brookline, Mass.
MOORE, CHESTER A. . . . . 6 Beacon St., Room 808, Boston, Mass.
SUMNER, MERTON R.,
Care Fred T. Ley & Co., Inc., 19 West 44th St., New York, N. Y.
THOMAS, JOHN F. . . . . Holbrook, Mass.

DEATHS.

WHITNEY, HARRIE L. . . . . October 14, 1918
WHITTET, RUFUS M. . . . . December 10, 1918

EMPLOYMENT BUREAU.

THE Board of Government has established an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society room two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

MEN AVAILABLE.

431. Graduate of University of Maine. Has had one year's experience as structural draftsman with Maine Central R. R., and two years' field experience as instrumentman and chief of party in shipway construction and hydrographic survey; has honorable discharge from U. S. Army. Salary desired, $30 to $35 per week.

432. Age 25. Graduate of Coöperative Engrg. School, Northeastern College, four-year course in civil engineering. Experience includes one year as transitman and draftsman with real estate engineer department of railroad, three years with Massachusetts Land Court, chiefly on calculation and drafting of Land Court plans and sectional maps, and thirteen months with U. S. Army, Heavy (Coast) Artillery; during last six months held commission as second lieutenant and instructed in surveying. Desires position as chief of party or draftsman. Salary desired, $125 per month.

433. Age 34. Received technical education from I. C. S. engineering course. Experience includes four years with Massachusetts State Dept. of Health on Neponset River improvement project, two years with Boston Transit Comm. on construction of Dorchester Tunnel, and eighteen months on shipyard construction. Desires position as chief of field party. Salary desired, $175 per month.

435. Age 25. Graduate of Mass. Inst. of Technology, 1916, civil engineering course; junior of B. S. C. E. Has had one and one-half years' experience on sewer work and six months on highway construction; for over a year has held commission in Coast Artillery Corps, U. S. A., during which time has had command of battery of 220 men and been in charge of mounting and dismounting 10-in. guns, building artillery emplacements, locating and establishing datum points in coast defenses, etc.; for past two months has been orientation officer. Desires outdoor position; will go anywhere in United States, preferably in Oregon, Washington or New England. Minimum salary desired, $150 per month.

436. Age 20. Graduate of Mechanic Arts High School; student for one and one-half years at Northeastern College of civil engineering. Has had three months' experience in general surveying and six months as transitman, levelman and chief-of-party on layout work at Squantum Destroyer Plant; recently discharged from Royal Flying Corps. Desires position as transitman and levelman on construction work. Salary desired, $24 per week.

437. Age 37. Student for one year at Mass. Inst. of Technology; three years' course in structures at Franklin Union. Experience includes one year as instrumentman and draftsman with Metropolitan Park Commission, one year as transitman with Charles River Basin Commission, three years as transitman and chief-of-party on railroad surveys and construction, three and one-half years as topographical draftsman with municipal bureau of engineering, three years as assistant to town engineer, and three years on general building work; recently discharged from U. S. Army, where held rank of first lieutenant, Engrs.

LIBRARY NOTES.

Recent Additions to the Library.

U. S. Government Reports.

Abrasive Materials in 1917. Frank J. Katz.

Accidents at Metallurgical Works in United States during Calendar Year 1916. Albert H. Fay.

Annual Report of Interstate Commerce Commission for 1918.

Annual Report of Secretary of Agriculture for 1918.

Arsenic, Bismuth, Selenium and Tellurium in 1916. Joseph B. Umpleby.

Asbestos in 1917. J. S. Diller.

Asphalt Deposits and Oil Conditions in Southwestern Arkansas. Hugh D. Miser and A. H. Purdue.

Barytes and Barium Products in 1917. James M. Hill.

Bibliography of North American Geology for 1917, with Subject Index. John M. Nickles.

Building Operations in Larger Cities in 1917. Jefferson Middleton.

Cadmium in 1917. C. E. Siebenthal.

Cannel Coal in United States. George H. Ashley.

Coal Fields of United States: Ohio. J. A. Bownocker.

Daily River Stages at River Gage Stations on Principal Rivers of United States for 1917. Alfred J. Henry.

Determination of Moisture in Coke. A. C. Fieldner and W. A. Selvig.

Economic Operation of Steam Turbo-Electric Stations. C. T. Hirshfeld and C. L. Karr.

Flaxville Gravel and Its Relation to Other Terrace Gravels of Northern Great Plains. Arthur J. Collier and W. T. Thom, Jr.

Fuel Briquetting in 1917. C. E. Lesher.

Fuller's Earth in 1917. Jefferson Middleton.

Fusibility of Coal Ash and Determination of Softening Temperature. Arno C. Fieldner and others.

Geologic Reconnaissance of Uinta Mountains, Northern Utah, with Special Reference to Phosphate. Alfred Reginald Schultz.

Geology and Oil and Gas Prospects of Lake Basin Field, Montana. E. T. Hancock.

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Vol. VI JANUARY, 1919 No. 1

BOSTON SOCIETY OF CIVIL ENGINEERS
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PAPERS AND DISCUSSIONS

SANITATION IN EMERGENCY SHIPYARDS.

By W. L. Stevenson.*

(Presented before the Sanitary Section, December 4, 1918.)

The Emergency.

In the latter days of the year 1916 the world's commerce faced a crisis. The enemy had destroyed 5 000 000 tons of shipping and an equal amount was interned, which represented one fifth of the world tonnage.

Under the American flag at that time only 2 500 000 tons of ships were in service, and of these 80 per cent. were engaged in coastwise and Great Lakes trade. Shipbuilding in the United States, once a flourishing industry, had decreased until relatively but a few shipyards were building boats and these in a leisurely manner. The war had slowed down Great Britain's output to one third its normal rate of construction. The Allies were therefore confronted with a most serious problem to maintain communication across the seas which was essential to the victory now won.

Broad-visioned men in authority in America realized that the welfare of the nation required that the Federal Government, with its boundless resources and ability to suffer losses and sustain them for an indefinite period, was the only body which could develop an American merchant marine to meet the crisis.

Congress therefore passed "The Shipping Act," which was

*Late Sanitary Engineer, Department of Health and Sanitation, United States Shipping Board Emergency Fleet Corporation.

approved September 7, 1916, creating the United States Shipping Board, which, "with the approval of the President, is authorized to have constructed and equipped — or to purchase, lease or charter — vessels for use as naval auxiliaries or army transports or for other naval or military purposes . . . ." The act also authorized the board to form "one or more corporations for the purchase, construction, equipment, . . . of merchant vessels in the commerce of the United States."

In accordance with this provision, the United States Shipping Board Emergency Fleet Corporation was created in April, 1917. All of the stock, except qualifying shares of trustees, is owned by the Shipping Board.

The Emergency Shipping Fund provision of the Urgency Deficiencies Appropriation Act, approved June 30, 1917, gave large powers to the President for the development of the merchant marine, and these powers were delegated to the United States Shipping Board and the Emergency Fleet Corporation by the executive order of July 11, 1917.

This legislation provided the authority to create the "bridge of ships" so sorely needed at that critical time.

In addition to the requirements of commerce, our entry into the war in April, 1917, demanded that ships be provided to transport our boys overseas and also more ships to keep them provided with supplies. Based upon our Allies' experience, it was expected that five tons of shipping space per man per year would be required for supplies — or 5 000 000 tons of shipping for supplies for each million men we put on foreign shores. Due to our improvements in methods of loading, unloading and speed, this was reduced to three tons. The magnitude of the problem confronting the Shipping Board can be appreciated when it is considered that in 1916 only 800 000 deadweight tons of ships were built in America.

About 2 800 000 deadweight tons of steel ships were under construction at that time and subject to commandeer. The original program of the Shipping Board for the first eighteen months was to construct 3 000 000 tons, but in July, 1917, Congress was asked for funds to build an additional 3 000 000 tons of ships.

THE BUILDING OF THE SHIPS.

Existing shipyards and ships under construction were requisitioned and their plants rapidly enlarged. Contracts were entered into to establish new shipyards all along the 7 000 miles of the Atlantic, Gulf, Pacific and Great Lakes shores, and existing and new industrial works all over the country were put to work to manufacture the equipment and furnishings of the ships.

As a result of the tremendous activities in the shipyards, the production of American ships last August exceeded the losses of both the Allies and neutral countries. Also two thirds of the tonnage lost was replaced by new construction by last October.

Before the war, from nine to twelve months were required to build a 3 500-ton steel seagoing vessel, from twelve to eighteen months to build a 5 500-ton steel vessel, and from eighteen to twenty-four months to complete a vessel of 8 000 tons and over. Last summer, the *Crawl Keys*, a steel freighter of 3 500 deadweight tons, was completed in thirty-four days. The *Tuckahoe*, a steel collier of 5 500 deadweight tons, was completed in thirty-seven calendar days, and the *West Lianga*, of 8 543 deadweight tons, in 78 days.

Last October there were under control of the Shipping Board 203 shipyards with 1 020 ways, which is double the total number of shipways of the rest of the world. Within the jurisdiction of the Shipping Board on September 1, 1918, there were 2 185 seagoing vessels, totaling 9 511 915 deadweight tons.

Thus did America arise to meet and accomplish the seemingly impossible task of bridging the sea to save civilization.

Success depended upon three main factors: (1) Administration, (2) materials, (3) labor.

I need only mention the names of Hurley, Schwab and Piez to show the reason for the wonderful success of the administrative function.

The obtaining of the materials for yard and ship construction and ship equipment was a matter outside my province.

In pre-war shipyards many of the various crafts were near akin to the "castes" of India, — son following father, from generation to generation, and therefore the number of skilled

FIG. 1. INTERIOR OF A DISPENSARY.

FIG. 2. FIRST-AID STATION AND DISPENSARY.

shipbuilders was limited. The enormous demand for labor to build the emergency ships meant that the necessary forces had to be obtained from existing shipyards, allied trades, and lastly the deficiency made up from men with no prior experience — even in thousands of cases men having no experience in mechanical or manual or outdoor work.

The draft for the army and the demands for labor in all the other industries made the labor market very tense, and it was of utmost importance to the carrying out of the shipbuilding program that every measure tending to conservation of labor be adopted.

Realizing the need of applying modern health measures, Chairman Hurley of the Shipping Board requested Surgeon-General Gorgas of the United States Army to detail an officer of his staff to organize a health department.

The Department of Health and Sanitation.

Lieut.-Col. Philip Schuyler Doane, M. C., U. S. A. (then Major), was assigned by the Surgeon-General of the Army on November 14, 1917, and became the Director of Health and Sanitation of the United States Shipping Board.

He organized a staff of medical officers and sanitary engineers who covered all the shipyards in their investigations, rendering reports and recommendations to the home office in Washington, where Colonel Doane standardized and unified policies and carried out the preventive measures in the shipyards.

To understand the work of the department, several matters must be borne in mind.

The shipyard worker was not subject to orders, as was the enlisted man in the army or the navy. Furthermore, the enormous demand for labor made it almost imperative not to adopt any measures which appeared to be mandatory.

Work in the shipyards was being done under contracts of various kinds. Many were lump-sum contracts and contained no clause specifically requiring compliance with health or sanitary regulations. The impelling purpose in the minds of shipyard managers was to construct ways, erect derricks, obtain

material and labor so as to lay keels and build ships. Hence, those matters which did not show direct bearing on ship construction were neglected, such as the distribution of water by drinking fountains instead of by bucket and the common cup, and the use of water-closets instead of the exposure of fecal matter in unscreened privies.

The early work of Colonel Doane was therefore educational and diplomatic, to bring about a realization that it was essential

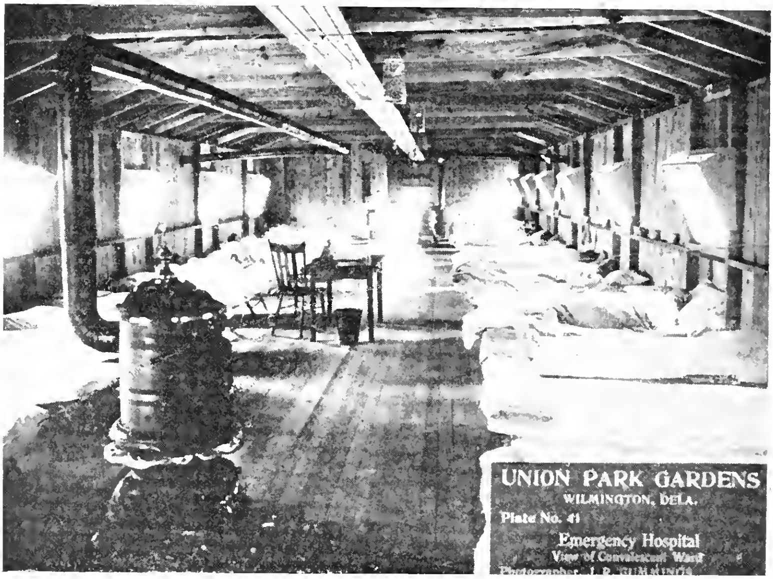

Fig. 3. Temporary Influenza Hospital.

to the conservation of the man-power to safeguard the workers against sickness, injury and loss of vitality.

The work of the department may be divided into: (*a*) medical and surgical; (*b*) sanitary engineering; (*c*) coöperation with civic state and federal health authorities for work in the extra shipyard zone.

The medical and surgical work consisted in securing first-aid stations and dispensaries (Figs. 1 and 2) for the care and treatment of injuries, facilities for resuscitation of drowned, care of

heat prostration cases in summer, ambulances, stretchers and other facilities for caring for the injured. Arrangements were made with town and private hospitals for admission of injured or sick shipyard workers. Fig. 3 shows interior of temporary influenza hospital. A campaign was conducted in collaboration with the surgeon-general of the army, the surgeon-general of the navy, the Committee of National Defense, and the Public Health Service, to control the venereal diseases by means of lectures, motion pictures, literature and the establishment of venereal clinics.

The sanitary condition of the extra shipyard zone has a very considerable influence upon the health of the workers, partly as an environmental factor but principally as affecting their home and living conditions.

These conditions were met by the most cordial coöperation of the civic and state boards of health all over the country, and it is a pleasure to record the great help which they have given to the shipbuilding program.

The importance of the sanitary engineering work of the department was recognized by Colonel Doane in a manner which will go a long way toward binding together those members of the medical and of the engineering profession who are engaged in waging the war against disease by preventive measures. Colonel Doane gathered together the following staff, who engaged in the work of the department as war service:

Home Office.	
Medical officer,	Dr. J. P. Sprague.
Sanitary engineer,	W. L. Stevenson.
Field.	
Medical officer,	Dr. W. H. Coon.
Field Sanitary Engineers.	
Northern Atlantic District,	C. E. Turner and G. T. Hammond.
Delaware River and Middle Atlantic districts,	G. H. Shaw.
Southern and Gulf districts,	J. L. Ludlow.
Southern Pacific District,	D. W. Bingham.
Northern Pacific and 11th District,	W. F. Langelier.
Great Lakes District,	S. A. Greeley.

General policies were adopted for the conduct of the department, which are set forth in a bulletin published last summer. Instead of stating abstract policies, it may prove more illuminating to describe specific instances of the work of the department. For obvious reasons, names and places will be omitted.

Sanitation in Emergency Shipyards.

Water Supply. — It was recognized that an ample supply of pure, clean, cool water properly distributed through the yard was an absolutely essential factor in maintaining health in the workers. Naturally, sources of water supply were very varied, and many interesting problems arose.

In a part of the country where wood ships were being built, a shipyard was supplied with water from the adjoining municipality. It was obtained from a formerly uninhabited, wooded watershed. But the shipbuilding industry caused the establishment of lumber camps on the watershed, with consequent but temporary contamination of the water.

Prompt installation of sterilizing apparatus was obtained upon our discovering this condition, and will protect this water supply during the relatively brief period that lumbering will be conducted on the watershed.

One of the largest shipyards is situated on a river, below a large city whose crude sewage is discharged into it. It was impractical to supply the shipyard with water from the city. Hence a water purification plant was installed, consisting of facilities for coagulation, sedimentation, primary disinfection with liquid chlorine, rapid sand filtration and secondary sterilization.

On account of the gross contamination of the raw water, very careful analytical watch has been kept over the operation of this plant not only by the shipyard management but also by the state department of health and our own forces.

By experience it has become possible to so operate the plant that *B. coli* is continuously absent from the filter effluent, making the second sterilization a factor of safety.

The means for distributing water were so varied that samples of each type would constitute an interesting museum illustrating how not to do it.

The larger yards generally had a system of water pipes, and in a few cases fairly good distribution by bubbler fountains. The two essential characteristics recommended for a sanitary drinking fountain are that the jet of water shall be inclined so that it cannot fall back upon the orifice and that the orifice shall be so housed that the drinker cannot place his mouth upon it.

In the distribution of water in the hulls during construction and outfitting, it was found to be very difficult to overcome the

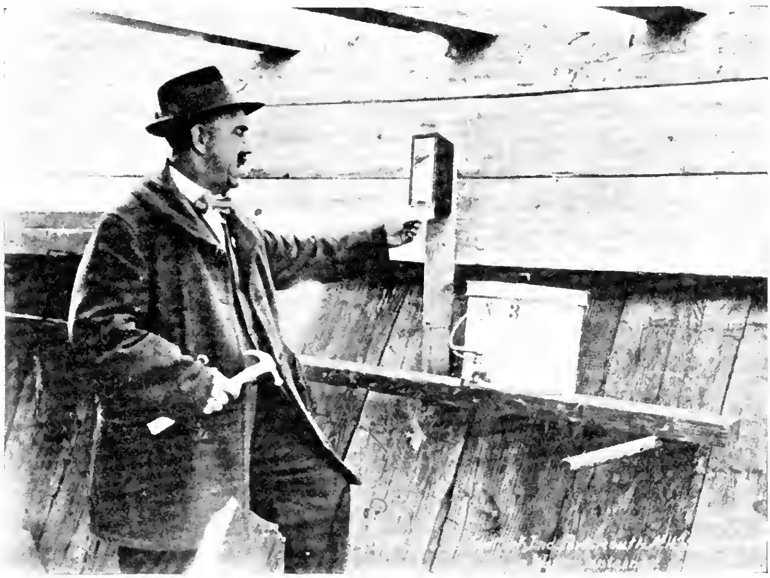

FIG. 4. METHOD OF DISTRIBUTION OF WATER WITHIN HULLS OF SHIPS DURING CONSTRUCTION.

practice of having the water-boy and dipper, so common on all old-fashioned construction work. The influenza epidemic afforded an opportunity to have installed in many yards covered barrels with a spigot for fixed positions, and smaller covered metal containers also having a spigot for portable distributors, and the use of individual paper drinking cups. (Fig. 4.)

As fire protection is of great importance in the shipyards, it is quite common to find that there are two systems of water

mains, one carrying water for industrial and fire-fighting purposes and the other the drinking water.

The fire mains are connected to emergency fire pumps, whose suction is in the near-by river or harbor, and hence frequently carry seriously contaminated water.

It was found that the two systems were sometimes connected with only a gate valve between the polluted and the drinking water. A most interesting case of this kind was found in a shipyard which had been in existence many years before the war. In connection with the shipyard was an industrial village of about 7 000 inhabitants. Its water supply was obtained from artesian wells of unquestioned purity, which was distributed through a system of pipes laid twenty or twenty-five years ago.

The increased use of the system caused high friction losses, resulting in very inadequate pressure for fire-fighting purposes at the end of the village farthest from the standpipe.

The water for the fire mains in the shipyard proper was obtained from a dock into which discharged the main sewer from the industrial village.

The two systems were inter-connected, and when an alarm of fire was sounded in the village the fire pumps were started and the gate valve in the connection opened to boost the pressure in the village.

When the fire was extinguished, the residents in the village allowed their spigots to run " until the water did not taste brackish." Of course, we immediately took steps to have new mains laid and a storage reservoir provided for the village, so that the two systems could be absolutely separated. But as this would take some time to complete, we temporarily had a liquid chlorine apparatus installed, so that all contaminated water pumped into the drinking-water mains would be very heavily dosed with the sterilizing agent.

In all cases where it appeared absolutely essential to maintain a dual connection between contaminated fire or industrial water mains and those carrying drinking water, if the health authorities having jurisdiction permitted, we had installed two check valves with gate valves, pressure gages and blow-offs, so that the tightness of the checks could be tested at monthly in-

tervals and that the bonnets of the check valves could be removed and the seats examined every three months.

In another yard during the construction period a serious outbreak of diarrhea occurred, apparently from the use of polluted water.

A reasonably safe municipal water was piped to but not through the yard. Water-boys were instructed to fill their buckets from a spigot on this service near the yard entrances. A temporary line of pipe was laid on the ground through the yard to several concrete mixers, and it was supplied by a temporary pump on the bank of a river. About two miles above the shipyard the entire sewage of a large city entered the river near by. The sewage from the small adjoining town was discharged and, within fifteen feet of the suction of the pump, a privy was located over the river for temporary use of the workmen pending construction of the yard water-closet toilet. It was found that, contrary to orders, the water-boys had filled their buckets several times from the hose at the concrete mixers, with the inevitable result.

The construction work could not be stopped, so a temporary bleach apparatus was set up in the pump house, and sufficient hypo solution delivered into the suction line to make it very unlikely that the men would drink the water on account of the taste of the bleach.

As an example of the need for technical supervision over water supplies, the case may be cited of a shipyard located near a small town which had no public water supply. First a well was sunk, but the water proved too brackish, and could not be used for drinking. The management, evidently having read in advertisements of bottled water of the purity of distilled water, rigged up some open barrels and condensed their exhaust steam. Water-boys dipped their buckets in these barrels and, of course, the common cup was used by the men. Upon advices from the department of the danger of this procedure, they sunk five wells about thirty feet deep in open, unoccupied country, but when our field representative next called he was just in time to prevent them from carrying out a plan to locate a barracks for the armed guard in the immediate vicinity of the new wells.

Sewage Disposal. — Next in importance to securing pure water supplies was the sanitary disposal of excreta, and, as might be expected upon first inspection, it was very common to find grossly insanitary methods in use, such as open privies on land, and drop toilets over the water frequently well above low-water mark, resulting in exposure of the fecal matter until the high tide washed it away. Where it appeared advisable to maintain privies, they were made over a trench, carefully

Fig. 5. Shipyard Toilet Room.

screened, the seats provided with self-closing lids, and dry earth used to cover the excreta. Furthermore, they were provided with urinal troughs which led not to the trench but to a separate excavation which was filled with broken stone or gravel and covered by earth and sod. These proved to be quite inodorous and satisfactory.

Generally, however, water-closet toilets (Fig. 5) having open-front seats were recommended, and the sewage carried by sewer to a proper point of discharge. An interesting case of

improvement in sewerage conditions occurred in a shipyard where the field sanitary engineer reported that " Mr. ——— [the manager] has the reputation of not putting much stock in what he would term " ' modern stuff.' " There were two drop toilets with no water under them. They consisted merely of a rail and a shelter, and were very foul.

A broken municipal sewer near by permitted the sewage to flow over the surface of the ground. As there was no restaurant at the yard, the men ate their lunch promiscuously in the open, and in proximity to the sewage and the drop toilets and in the midst of myriads of flies.

Army officers had refused to send an armed guard to the yard on account of these insanitary conditions, and we were informed that no municipal funds were available to reconstruct the sewer. Upon receipt of a telegram from us, the City Council at once appropriated the funds needed, the sewer was reconstructed, and now the yard has a proper toilet connected to the sewer.

The use of drop toilets located over the water near the shipways was very common, especially in the early days. In one yard our inspector found that it was the practice to allow certain timbers to float in the water practically under such a toilet, and it required some little persuasion to induce them to abandon the practice. Later, a few cases of typhoid developed in this particular yard, and the management had been sufficiently enlightened so that they did all they could to help us carry out an educational campaign among their men which resulted in the vaccination for typhoid and paratyphoid of about eighty per cent. of the workers.

Washing Facilities. — The securing of proper washing facilities for the workers proved to be a somewhat difficult matter, especially in the smaller yards, the argument made being that the men would not use them even if they were provided, on account of their desire to hurry home as soon as the work period expired. In a goodly number of yards, however, we secured wash troughs having free outlets and provided with hot and cold spigots above, so that the men were forced to wash in running water. (Fig. 6.)

In the South, especially, efforts were made to obtain installation of shower-baths, and it was gratifying to note the increasing popularity of them among the men after they learned the refreshing effect.

Garbage. — Garbage collection and disposal were very much neglected in the early days. In many yards having restaurants and lunch rooms, the garbage was collected in open containers

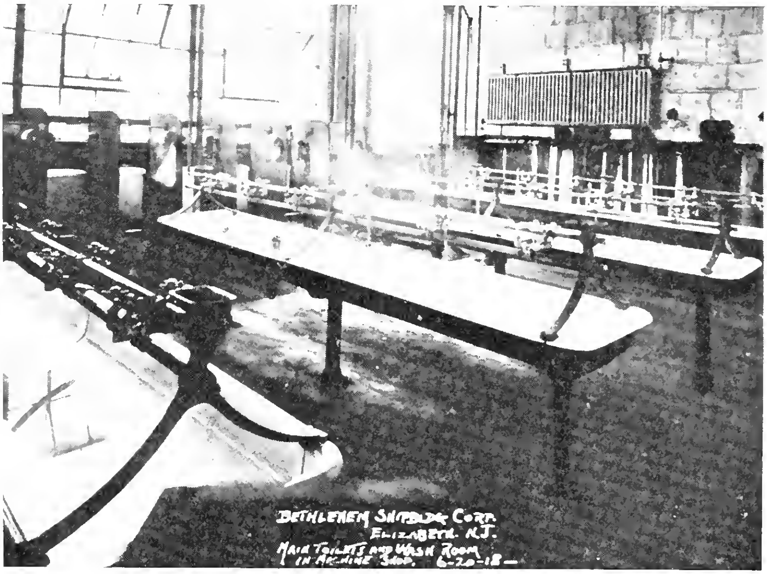

Fig. 6. Shipyard Wash Room.

and removed when convenient, thus affording splendid breeding places for flies in immediate proximity to the food.

We succeeded, in nearly all cases, in securing the use of impervious covered containers and the daily removal of the garbage for disposal beyond influence upon the yards or the homes of the workers.

At one yard, the management bought a few pigs to whom the garbage was fed. The men took a wonderful interest in them, and it is claimed that it was a very profitable venture. But this means of garbage disposal was not encouraged, as it

generally was found that the resulting fly nuisance was a serious matter.

Flies. — On a first visit during warm weather of one of our inspectors to a shipyard, he noticed a large pile of manure about midway between the restaurant and the office, and one of the very first questions asked him by the management was why they had such a pest of flies. As a result of the visit, a sanitary manure pit was constructed, doors and windows were screened, and fly-traps made and used.

Flies were found to be one of the common menaces of the yards, and not as easy to control as may be imagined.

Every effort possible was made to screen and keep clean the eating places of the workers. When the noon hour came, the men would all endeavor to enter the restaurants at once, resulting in the entrance door being kept open. To obviate this, we endeavored to obtain a vestibule entrance with double screen doors and an electric fan causing an out-draft.

A large yard, well provided with its own sanitary department and internally kept in a clean condition, was seriously troubled with flies. The near-by city, prior to the establishment of the shipyard, had caused to be removed a considerable number of piggeries in the neighborhood. Our investigations showed, however, that in the adjoining county and within influence upon the shipyard there were about twenty-two grossly insanitary pigpens.

By due process of law, the owners were served with notices to abate the nuisance, with marked effect upon the prevalence of flies at the shipyard. Fig. 7 illustrates a poster distributed by the Department of Health and Sanitation, United States Shipping Board.

Mosquitoes. — The control and elimination of mosquitoes was probably one of the largest and most spectacular activities of our health department.

The largest project covered 10 000 acres of low land, which already had a system of main and lateral ditches amounting to 120 miles, which, however, were not in good condition.

A pumping station of 180 000 000 gals. a day capacity was installed, 55 000 gals. of oil used, 45 miles of ditches cleaned,

1 750 000 sq. ft. of vegetation mowed to expose the surface of water for inspection and oiling, etc. The total cost for 1918 was $270 000, and a maximum force of 600 men was employed.

The result of this work was the practical elimination of mosquitoes at the shipyard.

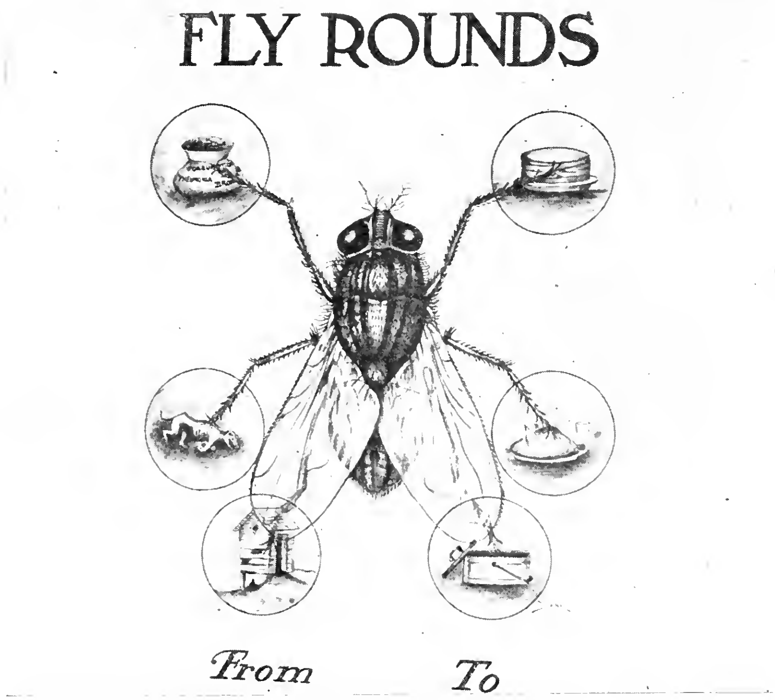

FIG. 7. FLY POSTER.

Vermin. — A shipyard near a fairly large city suffered from an invasion of rats which proved nearly as troublesome as those which we read of at Hamlin town. As we had no pied piper, resort was made to an investigation of their origin, which was found to be in the near-by garbage dump of the city, and relief was obtained by proper maintenance of the dump.

Restaurants. — The securing of proper eating facilities for the workers was another difficult problem. Some shipyards, recognizing the importance of this factor, provided most excellent restaurant facilities (Fig. 8), while others by neglect afforded opportunities for uncontrolled and hence generally unsatisfactory eating places to spring up at the yard entrance.

Over these we had no direct control, but through the kind offices of the civic and state health boards we were able to secure control and great improvement in their sanitary condition.

FIG. 8. SHIPYARD RESTAURANT.

CONCLUSIONS.

There were many other problems, such as housing conditions, which involved interesting features of sanitation but which require for proper elucidation more space than is now available, and hence are omitted.

A matter that should not be lost sight of is the educational feature of our work. It is hoped and believed that a goodly

percentage of the shipyard workers were taught lessons of personal hygiene through their experience in the shipyard, and that this knowledge will not be forgotten but be carried through life to the betterment of the nation.

The war is ended with victory to our arms. There is not a shadow of a doubt but that the shipping program was one of the most important factors in winning the war. And we believe that the maintenance of the shipyard workers in a vigorous state of body and contented mind played at least a part in the success.

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BOSTON SOCIETY OF CIVIL ENGINEERS
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PAPERS AND DISCUSSIONS

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AUTO CATCH-BASIN CLEANING TRUCK, CAMBRIDGE, MASS.

BY LEWIS M. HASTINGS,* MEMBER BOSTON SOCIETY OF CIVIL ENGINEERS.

AT the meeting of the Sanitary Section of the Boston Society of Civil Engineers held in January, 1917, the topic of "Catch-Basin Construction and Maintenance" was presented and discussed by various members of the Society, and much interesting data was presented at that time. Since that meeting, the City of Cambridge has had constructed, for the purpose of cleaning out and removing the material from its street catch basins, an auto catch-basin cleaning machine which has now been in service some six months on this work. (Fig. 1.)

The city first purchased a $3\frac{1}{2}$-ton auto truck equipped with a special steel body of three cubic yards' capacity and a wood auto dump hoist for dumping the load by power obtained from the truck engine. This power hoist has been found of very great service in the saving of time and labor in dumping the heavy loads at the dump.

The excavating and loading of the material from the basins is done by means of an orange-peel excavating bucket 18 ins. in diameter and about 16 ins. deep, holding about 1.50 cu. ft. of material. This bucket is opened and shut by a piston and cylinder attached to the head of the bucket, and operated by compressed air at a pressure of about 100 lbs. per sq. in.

* City Engineer, Cambridge, Mass.

Compressed air is obtained by a Rand-Ingersol air compressor, Type 12, located on a frame at the left side of the chassis frame. Power to drive the compressor is obtained from the main engine shaft or propeller by a sprocket and chain drive to the shaft of the compressor. The compressed air is led to the bucket by two lines of $\frac{3}{8}$-in. armored rubber hose. Underneath the platform on which the operator stands is a sliding valve or controller with which the two hose lines are connected, and by which the air is put into one hose line to open and into the other

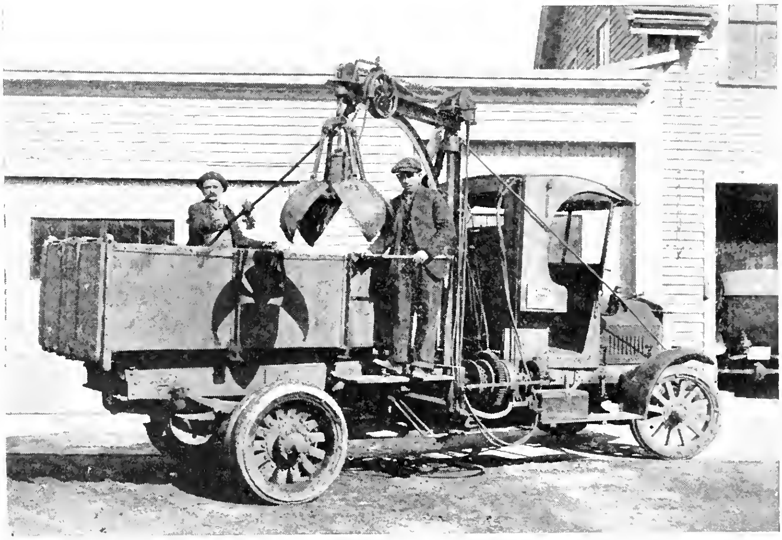

Fig. 1. Auto Catch-Basin Cleaning Truck, Cambridge, Mass.

hose line to close the bucket, by pressing down or releasing the valve with the foot. The two hose lines are passed over pulleys on the crane and move back and forth with the hoisting chain as the bucket is raised and lowered. This hose feed device is a recent attachment and saves the services of one man formerly required to tend the hose.

The power to raise the bucket is obtained by another sprocket on the propeller shaft driving a chain to the right of the chassis connecting by a simple arrangement of clutch and gears to the

drum or reel operating the chain to which the bucket is attached. The bucket is lowered by its own weight controlled by a brake and drum on the countershaft applied by the operator's foot.

Both driving sprockets are controlled by one jaw clutch on the propeller, so that when this clutch is disengaged the engine is free to run the dump hoist or the motive transmission without running the excavating machinery.

Most of the special machinery was made at local machine shops from detail drawings made in the Engineering Department. The total cost of the plant, exclusive of some changes made after the first use of the machine, has been about $6 000.

The use of the machine has been almost entirely in the easterly part of the city, while the dump is near the extreme westerly end, making the haul to the dump average about $2\frac{1}{2}$ miles.

At the same time that the machine has been working in the easterly section, a gang of two one-horse carts carrying about $1\frac{1}{6}$ cu. yds. to a load, with four men, was working in the westerly section with a haul of about one mile to the dump.

Perhaps a comparison of the estimated costs by these two methods of catch-basin cleaning under conditions as they exist in Cambridge may be of interest. It should be borne in mind that these conditions — high wages, short hours, vacations, holidays, pensions, etc. — are not such as to produce a very low unit cost by either method, and also that if the length of haul were equal in each case the costs would be still more favorable to the truck.

City of Cambridge — Costs of Cleaning Catch Basins, 1918.

By Auto Truck.

Four trips @ 3 cu. yds. x 5,				60 cu. yds.
Saturday, 2 x 3 x 1,				6 cu. yds.
				66 cu. yds. weekly, or 11 cu. yds. daily average.
Chauffeur,	@	$4.00,	$4.00	
2 laborers,	@	3.25,	6.50	
Gasoline, 7 gals.,	@	.25,	1.75	
Oil,			.20	
Grease,			.15	
				$12.60 per day.
Tires,			$250.00	
Repairs,			300.00	
Depreciation, $6 000 @ 20%,			1 200.00	
Interest on investment, $6 000 @ 4%,			240.00	
Yearly overhead costs,			$1 990.00	

$$\frac{\text{Yearly overhead costs, } \$1\,990.00}{\text{Assume 250 working days, } 250} = 7.96$$

Cost per day, $20.56

20.56 ÷ 11 = $1.87 per cu. yd.

By Horse Carts.

5 to 6 loads daily, average $5\frac{1}{2}$ loads, $1\frac{1}{6}$ cu. yds. per load.

1.16 x 5.5 loads x 5 days,				32.0 cu. yds.
1.16 x 5.5 loads x $\frac{1}{2}$ day Saturday,				3.2 cu. yds.
				35.2 cu. yds. weekly, or 5.86 cu. yds. daily average.
Labor, 4 men	@	$3.25,	$13.00	
2 horses,	@	1.50,	3.00	
				$16.00 per day.
Interest, $575 x 2 @ 4%,			$46.00	
Depreciation, $575 x 2 @ 15%,			172.50	

$$\frac{\text{Yearly overhead, } \$218.50}{\text{Working days, } 250} = .87$$

Cost per day, $16.87

$16.87 ÷ $5.86 = $2.88 per cu. yd.

MEMOIR OF DECEASED MEMBER.

FRANK S. HANF.*

FRANK SIDNEY HANF, son of Henry S. and Hannah (Chatwind) Hanf, was born in Saxonville, Mass., November 24, 1891. The family removed to Chelsea about 1893, and the boy Frank passed through the grammar and high school there, after which he took courses in engineering and kindred subjects at the Franklin Union and at Boston Y. M. C. A. School, now Northeastern College, having in the meantime taken a place in the engineering department of the Boston and Maine Railroad in September, 1912. In June, 1913, he entered the engineering office of the Massachusetts Highway Commission; in January, 1914, changed to the Boston and Albany Railroad; and in February, 1915, went to the Boston and Maine, this time with the valuation engineers. Through the open season of 1916 he was a resident engineer for the Highway Commission, and passed the winter of 1916–17 in the Valuation Department of the New York, New Haven and Hartford Railroad.

Up to this time, Mr. Hanf, although the grandson of a soldier who fought in the Crimean War, had shown no especial interest in military matters, but the outbreak of war with Germany in April created an entirely new situation, to which he was not slow to adjust himself. Responding promptly to the urgent demand of the time, he enlisted with the New England Engineers, and after some weeks of training at Plattsburg and at Washington, D. C., he received his commission as second lieutenant in the Engineer Officers' Reserve Corps, June 28, 1917. In September he was stationed at Camp Lee, Va., and sailed for service in France, December 11, 1917.

While on duty with the First U. S. Engineers at Broyes, France, on April 28, 1918, he was killed by a shell, and was buried in the cemetery there in the evening of the same day.

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* Memoir prepared by F. P. Perkins, F. B. Rowell and Chas. H. Restall.

Lieutenant Hanf became a member of the Boston Society of Civil Engineers April 18, 1917. He was a member of the Cary Avenue Methodist Church in Chelsea, and was a modest and serious-minded man, painstaking and conscientious in his business, and of a very genial and friendly disposition. The captain to whose company he was attached in France described him as a fine officer and a man of the highest character.

Vol. VI FEBRUARY, 1919 No. 2

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PROCEEDINGS

PAPERS IN THIS NUMBER.

"The Operation of the Utilities at Camp Devens, Mass." Edward W. Briggs.

"Discussion of the Open-Air Treatment of Influenza." Charles F. Dingman.

Memoir of Deceased Member.

Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

BINDING SOCIETY JOURNAL.

The Secretary has made arrangements for binding Volume 5 of the Journal of the Society. The ten numbers will be bound in one volume, the style of binding to be uniform with that of previous volumes. The price of binding this year will be $1.00 per volume.

Numbers for binding must be sent to 715 Tremont Temple, Boston, before April 1, 1919. After this date, numbers will not be accepted for binding except with the understanding that they cannot be bound at the price named.

MINUTES OF MEETING.

Boston, January 22, 1919. — A regular meeting of the Boston Society of Civil Engineers was held this evening at

Chipman Hall, Tremont Temple, and was called to order at 8 o'clock by the President, Charles M. Spofford.

There were 59 members and visitors present.

The record of the December meeting was read and approved.

The President reported for the Board of Government the election to membership in the grade of Member of Mr. Clarence Schuyler DePuy, and in the grade of Junior of Mr. Walter Augustine Woods.

The Secretary presented for Messrs. George A. King and Luther Dean, the committee appointed for the purpose, a memoir of Frank Albert Peirce, a member of the Society, who died August 7, 1917. The memoir was accepted and ordered printed in the JOURNAL.

The President announced the deaths of the following members of the Society, and the President was requested to appoint committees to prepare memoirs:

Harrie L. Whitney, who died October 14, 1918.
Charles C. Doten, who died December 28, 1918.
Past President Frederick Brooks, who died January 10, 1919.

Mr. John C. Chase said that the announcement of the death of Past President Brooks brought to his attention the small number of members of the Society remaining with us, who were responsible for the resuscitation of the Society in 1874, and he felt that some special recognition was desirable. While it might not be best to elect them all to honorary membership in the Society, he did think that they should be elected to some form of life membership.

He moved and it was so voted: That the Board of Government be requested to consider the propriety of making these members honorary or life members.

Mr. Hale brought to the attention of the meeting the existence of a committee appointed by the Board of Government to look out for the interests of engineers in any bills coming before the present legislature, and asked that this committee, of which he is chairman, be notified of any such proposed legislation known to any of our members.

The President then called on Mr. Robert Spurr Weston to read the paper of the evening, entitled "The Disposal of Sewage by Treatment with Acid," which had been prepared by him in conjunction with Mr. Edgar S. Dorr.

A discussion followed, in which the following took part: Mr. Harry W. Clark, chemist, Massachusetts Department of Health, and Messrs. Edgar S. Dorr, Almon L. Fales, Hartley L. White, George A. Carpenter and Robert Spurr Weston.

Adjourned.

S. E. Tinkham, *Secretary.*

APPLICATIONS FOR MEMBERSHIP.

[February 15, 1919.]

The By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

Dickson, Arthur Donohue, Cambridge, Mass. (Age 25, b. Cambridge, Mass.) Graduate of Mass. Inst. of Technology, 1917, civil engineering course, degree of B.S. Was office assistant and assistant foreman with George W. Macauley, builders' finish manufacturer, Boston, for period of year and a half before entering preparatory school; assistant superintendent of construction with Stone & Webster at Falls Village, Conn., during summer of 1916;

on entry of United States into the war, applied for commission in Coast Artillery Corps, Regular Army, and successfully passed examination for second lieutenant; has since been promoted to rank of captain, Regular Army; has recently resigned commission in order to follow engineering profession. Refers to J. B. Babcock, H. W. Hayward, G. L. Hosmer, J. W. Howard, E. F. Miller and C. M. Spofford.

McGovern, Patrick, New York, N. Y. (Age 47, b. Ireland.) Is contractor. Refers to F. H. Fay, C. R. Gow, J. W. Rollins, C. M. Spofford and S. Everett Tinkham.

Reeds, Clarence, Lowell, Mass. (Age 34, b. La Cygne, Kan.) Graduate of Univ. of Oklahoma, 1905, degree of A.B. in mathematics; graduate of Mass. Inst. of Technology, 1909, degree of S.B. in mechanical engineering. From June to September, 1909, with Engr. Dept. of associated Factory Mutual Fire Insurance Co., Boston; from September, 1909, to January, 1910, engineer with United Cork & Seal Co., Millis, Mass.; from January, 1910, to date, engineer with John A. Stevens, Cons. Engr., Lowell, Mass., on various engineering problems embodying analyses, original design and construction of power plants; has had charge of analyses of power, light and heating problems for General Electric Co.'s entire plants at Lynn, Mass., and Schenectady, N. Y.; has also had charge of design and supervision of construction of power plant revisions including 30,000 kw. steam plant for Turners Falls Power & Electric Co. at Chicopee, Mass. Refers to R. E. Barrett, W. W. Bigelow and G. H. Thorpe.

ROLL OF HONOR.*

ADDITIONS.

Sheils, Henry C. Ensign, Aviation Service, U. S. N., Inspector of Naval Aircraft, Keyport, N. J.

† Shute, George P. Captain, Q. M. C., Water and Sewer Section.

REVISIONS.

Bresth, Alexander. 1st Lieutenant, Sanitary Corps, U. S. A., Camp San. Engr., Camp Wadsworth, S. C.

Bussey, Byron C. 1st Lieutenant, U. S. A., 11 Star St., Pawtucket, R. I.

Coburn, William H. Captain, Gas Defense Div., Chemical Warfare Service, U. S. A., 19 West 44th St., New York, N. Y.

† Cowles, Martin W. 2d Lieutenant, Sanitary Corps, U. S. A., San. Squad, 9th Div., Camp Sheridan, Ala.

DeMerritt, Robert E. 1st Lieutenant, C. A. C., U. S. A., Fort Levett, Me.

* Members who are in the service and have not yet reported that fact to the Secretary are earnestly requested to do so, stating branch of service, rank and military address.

† Home address given below in "List of Members."

DURHAM, HENRY W. Major, Engrs., U. S. A., Dept. of Const'n and Forestry, A. P. O. 717, Am. Ex. Force, France.

ELLSWORTH, SAMUEL M. Lieutenant, U. S. A., Sales Commissary, A. P. O. 762, Le Mans, France.

FERNALD, GORDON H. Captain, Co. D., 304th Engrs., Am. Ex. Force.

LEONARD, JOSEPH F. A. 1st Lieutenant, Engrs., U. S. A.; Officer in Charge, Engr. Sub-Depot, commanding 421st Engrs. (Depot), Camp Wadsworth, Spartanburg, S. C.

LUTHER, HOWARD B. Lieutenant, Const'n Corps, U. S. N. R. F., Bureau of Const'n and Repair, Navy Dept., Washington, D. C.

NASH, PHILIP C. Captain, Engrs., U. S. A., Washington Barracks, Washington, D. C.

PATSTONE, LEWIS F. Major, Engrs., U. S. A., Camp Humphreys, Va.

PHILLIPS, LAURENCE J. Sergeant, Co. C, 212th Field Signal Battalion, Camp Devens, Mass.

RICHMOND, CARL C. 1st Lieutenant, Co. A, 605th Engrs., A. P. O. 931, Am. Ex. Force.

SNOW, LESLIE W. Captain, Ordnance Dept., U. S. A., Rochester, N. H.

SPEAR, WALTER E. Major, Q. M. C., U. S. A., Utilities Officer, Camp Upton, N. Y.

TOSI, JOSEPH A. 1st Lieutenant, 28th MG Battalion, U. S. A., Camp Funston, Kan.

WARING, CHARLES T. Major, Supply Div., D. M. A., U. S. A., Wilbur Wright Air Service Depot, Fairfield, Ohio.

WRIGHT, EDWARD. Captain, Sanitary Corps, Camp San. Engr., Camp Benning, Columbus, Ga.

LIST OF MEMBERS.

ADDITIONS.

BERKOWITZ, S. ROSS....................Hotel Coolidge, Brookline, Mass.
DEPUY, CLARENCE S.,
War Dept., Const'n Div. of Army, Room 1-234, Washington, D. C.
WOODS, WALTER A......................19 Oxford St., Somerville, Mass.

CHANGES OF ADDRESS.

ALLBRIGHT, EDWIN F................568 Columbia Rd., Dorchester, Mass.
BAKER, LLOYD E......................51 Congress Ave., Providence, R. I.
BARNES, T. HOWARD.......17 Battery Place, Room 1608, New York, N. Y.
BEAN, THOMAS W.......................180 Chestnut St., Holyoke, Mass.
BLAKE, EDMUND M....................Care Charles R. McCormick & Co.,
Fife Bldg., California and Market Sts., San Francisco, Cal.
BONNET, FREDERIC, Jr...............Care Atlas Powder Co., Landing, N. J.
BOWERS, GEORGE W.....................359 Westford St., Lowell, Mass.

Butcher, William L. . . . . 245 State St., Boston, Mass.
Carter, Clarence E. . . . . 23 Hanscom Ave., Reading, Mass.
Clark, Frederick, H. . . . . Camden, Me.
Cowles, Martin W. . . . . Mill Plain Rd., Fairfield, Conn.
Cross, Ralph U. . . . . 130 Burncoat St., Worcester, Mass.
Eisnor, John J. . . . . 60 Clarendon Ave., West Somerville, Mass.
Emerson, Ralph W. . . . . 51 North St., Pittsfield, Mass.
Forbes, Fred B. . . . . 541 State House, Boston, Mass.
Foster, Clarance L. . . . . 67 Thurston St., Somerville, Mass.
Gibson, Frederick M. . . . . 1906 Beacon St., Brookline, Mass.
Gillett, Laurence A. . . . . 718 Straley Ave., Princeton, W. Va.
Gregory, John H. . . . . Homewood, Baltimore, Md.
Grover, Nathan C. . . . . The Northumberland, Washington, D. C.
Gulesian, Selden J. . . . . 225 Endicott Ave., Revere, Mass.
Hall, Charles L. . . . . 11 Seaborn St., Dorchester, Mass.
Hart, Frank S. . . . . 110 Franklin St., Framingham, Mass.
Horne, Ralph W. . . . . 90 Ashland St., Malden, Mass.
Horton, Freeman H. . . . . 1023 22d St. N. W., Washington, D. C.
Howard, David R. . . . . 241 Winter St., Woonsocket, R. I.
Hughes, Hector J. . . . . Harvard University, Cambridge, Mass.
Jones, Pusey . . . . Room 7-E, North Station, Boston, Mass.
Jonsberg, Frank F. . . . . 601-4 Old South Bldg., Boston, Mass.
Katz, Harry L. . . . . 925 Harlem Ave., Baltimore, Md.
Kearns, William F. . . . . Boston Army Supply Base,
Summer St. Extension, So. Boston, Mass.
Kerstein, Benjamin H. . . . . 20 Canterbury St., Dorchester, Mass.
Killion, Louis J. . . . Care Monks & Johnson, 99 Chauncy St., Boston, Mass.
Kimball, Ernest R. . . . . 40 Upland Rd., Arlington, Mass.
Kirkpatrick, Charles D. . . . . 30 State St., Boston, Mass.
Kitfield, Edward H. . . . . 92 Water St., Boston, Mass.
Manley, Henry, Jr. . . . . 49 Lafayette St., New York, N. Y.
Manley, Laurence B.,
Dept. of City Transit, 1211 Chestnut St., Philadelphia, Pa.
Mann, William H. G. . . . . 95 No. Main St., Penacook, N. H.
Morris, Frank H. . . . . 95 Hudson St., Somerville, Mass.
Morse, William F. . . . . 10074 Keemar Park, Cleveland, Ohio
Negus, Arthur I. . . . . Care Charles H. Tenney & Co., Hampton, Va.
Newsom, Reeves J. . . . . 9 Portland St., Lynn, Mass.
Nichols, John R. . . . . 99 Chauncy St., Boston, Mass.
Peaslee, Dana N. . . . . 11 Cliffside Ave., Swampscott, Mass.
Preble, J. Jarvis . . . . 58 Howard St., Waltham, Mass.
Rice, Otis D. . . . . 19 Adams St., Winthrop, Mass.
Rich, Malcolm . . . . 155 Braddock Park, Boston, Mass.
Sauer, Fred E., Jr. . . . . 92 Trenton St., Melrose, Mass.
Scully, John T. . . . . 166 Devonshire St., Boston, Mass.

SHERMAN, HERBERT L.,
Care Arthur D. Little, Inc., 30 Charles River Rd., Cambridge, Mass.
SHORROCK, JOHN W. . . . . Y. M. C. A., Newburyport, Mass.
SHUTE, GEORGE P. . . . . 1713 Baird Ave., Portsmouth, Ohio
SMITH, SIDNEY . . . . 25 Garden St., W. Roxbury, Mass.
SMULSKI, EDWARD . . . . 15 East 40th St., New York, N. Y.
STENBERG, THORNTON R. . . . . 416 Pierce Ave., Houston, Tex.
SUMNER, MERTON R. . . . . Care Fred T. Ley & Co., Inc., Springfield, Mass.
THAYER, BURDETT C. 12 Farnsworth St., Boston, Mass.
THOMAS, J. FRANKLIN . . . . 50 Bromfield St., Boston, Mass.
TUCKER, FRANCIS C. . . . . 1938 Home Ave., Rogers Park, Chicago, Ill.
VICKERY, GILBERT S. . . . . Care Bethlehem Steel Co., Steelton, Pa.
WADE, W. NEWELL . . . . . . 1399 Commonwealth Ave., Suite 15, Allston, Mass.
WEBB, GEORGE F. . . Care Supervising Engr., Camp Bragg, Fayetteville, N. C.
WOOD, HENRY B. . . . . 473–C State House, Boston, Mass.
YOUNG, ERVING M. . . . . 415 William St., Key West, Fla.

DEATHS.

BROOKS, FREDERICK . . . . January 10, 1919
DOTEN, CHARLES C. . . . . December 28, 1918
HAYES, JAMES, Jr. . . . . September 26, 1918

EMPLOYMENT BUREAU.

THE Board of Government has established an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society room two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

MEN AVAILABLE.

438. Age 36. Received technical education at University of Maine. Has had twenty years' experience on sewer, water and highway work and general surveying. Desires position as chief-of-party. Salary desired, $35 per week.

439. Age 35. Graduate of Dartmouth College, degree of C.E. Experience covers five years' teaching of engineering subjects, one and one-half years as chief-of-party on subway construction, two years on supervision of construction, studies, plans and estimates for grade crossing eliminations,

New York, N. Y., and one year as chief-of-party and inspector on shipyard construction, including buildings, docks, pile-driving, reinforced concrete sewer and reinforced concrete shipways. Desires position as engineer or draftsman.

440. Age 33. Graduate of Norwich University, civil engineering course, degree of B.S. Has had about seven years' experience, chiefly in municipal work; has been rodman, transitman and for three years chief-of-party in responsible charge of all lines and grades of street construction; has done general city surveying, some drafting and some concrete design; has also had several months' experience as field engineer on army supply base. Desires either construction work or surveying. Salary desired, $25 per week.

441. Age 25. Experience consists of three years in field on federal valuation survey, as chainman, rodman and recorder, and ten months as Instrument Sgt. in 58th Field Artillery Regt., U. S. A. Will accept any position at reasonable salary; railroad work preferred.

443. Age 23. Graduate of Mass. Inst. of Technology, 1918, engineering adminstration course, mechanical engineering option. Has had three summers' experience, one with General Electric Co. in motor-winding and stock-room departments, one with blower and furnace company in machine shop and drafting room, and one selling specialties of aluminum cooking utensil company; has spent last eleven months in naval aviation service, having recently received inactive duty orders. Desires position with engineering concern, with opportunity to learn business and eventually work into administrative side. Salary desired, $25 per week.

444. Age 43. Graduate of Mass. Inst. of Technology, 1898, electrical engineering course. Experience covers ten years with firm of consulting engineers in Boston, as chief assistant to one member of firm on power plant investigations, reports and design, both steam and hydraulic, on appraisal work of street railways, etc.; was responsible for plant design of large and small hydraulic and steam developments; was for four years partner in firm of consulting engineers on domestic engineering, heating, ventilating, lighting, etc., and some larger plant work; recently discharged from U. S. Army as Lieutenant-Colonel, after serving on Mexican border and with 26th Division overseas. Desires position of responsibility or partnership, preferably in or near Boston.

LIBRARY NOTES.

Recent Additions to the Library.

U. S. Government Reports.

Annual Report of Governor of Panama Canal for 1917-18.

Drainage Methods and Foundations for County Roads. E. W. James and others.

Effect of Grazing upon Western Yellow Pine Reproduction in Central Idaho. W. N. Sparhawk.

Fluorspar and Cryolite in 1917. Ernest F. Burchard.

Gypsum in 1917. Ralph W. Stone.

Magnesite in 1917. Charles G. Yale and Ralph W. Stone.

Manganese and Manganiferous Ores in 1916. D. F. Hewett.

Quaternary Geology of Southeastern Wisconsin. William C. Alden.

Quicksilver Deposits of Phoenix Mountains, Arizona. Frank C. Schrader.

Results of Observations Made at United States Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Maryland, 1915 and 1916. Daniel L. Hazard.

Results of Observations Made at United States Coast and Geodetic Survey Magnetic Observatory at Vieques, P. R., 1915 and 1916. Daniel L. Hazard.

Results of Spirit Leveling in New York, 1906 to 1911, inclusive. R. B. Marshall.

Santo Tomas Cannel Coal, Webb County, Texas. George H. Ashley.

Small Sawmills, their Equipment, Construction and Operation. Daniel F. Seerey.

Spirit Leveling in Illinois, 1914 to 1917, inclusive. R. B. Marshall.

Spirit Leveling in Kentucky, 1914 to 1916, inclusive. R. B. Marshall.

Structure and Oil and Gas Resources of Osage Reservation, Oklahoma, Parts A-N. David White and others.

Water-Supply Papers 412, 428, 432, 433, 435, 441, 465.

State Reports.

Maine. Report of Public Utilities Commission on Special Water Power Investigation, 1918.

New Hampshire. Biennial Report of State Highway Department for 1917–18.

New York. Annual Report of Public Service Commission for First District for 1916, Vol. I, Appendices A to F, Vols. II and III.

County Reports.

Wayne County, Mich. Annual Report of Road Commissioners for 1917–18.

Municipal Reports.

Albany, N. Y. Annual Report of Bureau of Water for 1917.

Gloucester, Mass. Annual Report of Water Commissioners for 1917.

Lynn, Mass. Annual Report of Commissioner of Water and Water Works for 1917.

Melrose, Mass. Annual Report of Public Works Department for 1917.

Miscellaneous.

American Society for Testing Materials: Proceedings for 1918, 2 vols. Gift of L. C. Wason.

American Society of Civil Engineers: Transactions for 1918. Vol. LXXXII.

Carnegie Foundation for Advancement of Teaching: Study of Engineering Education. Charles Riborg Mann. 1918. Gift of Desmond FitzGerald.

Cost of Power in State of Maine. (Reprinted from Special Water Power Investigation, Public Utilities Commission, State of Maine, 1918.) H. K. Barrows. Gift of author.

League to Enforce Peace: Win the War for Permanent Peace. William Howard Taft and others.

On the Road to Democracy. Alberto J. Pani.

Plumbing and Household Sanitation. J. Pickering Putnam. Gift of author.

LIBRARY COMMITTEE.

Vol. VI FEBRUARY, 1919 No. 2

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

THE OPERATION OF THE UTILITIES AT CAMP DEVENS, MASS.

By Major Edward W. Briggs.*

Ordinarily in building a city to accommodate a population of 40 000, considerable time would be spent in the selection of a site, in careful surveys of the land, in town planning and in preparation of building plans; but, in the emergency in which all the camps were built, time was the one important factor. Practically no information was available, either in this country or abroad, as to the requirements of these semi-permanent cantonments. Some slight information was obtained as to water allowance of the English and French armies, which, however, was far less than the 55 gals. per capita estimated necessary for our camps.

Considerable astonishment was expressed by many of the foreign officers attached for training purposes at the conveniences provided, but the wonderful results obtained in training men quickly and efficiently in a short time has quite evidently justified the expense of the complete systems installed. It must be remembered that the vast majority of these men who were selected to serve in our armies were accustomed to modern conveniences to be found in cities, the lack of which would have

* Officer in charge of Camp Utilities, Camp Devens, Mass.

Note. — This paper will not be presented at a meeting of the Society, but discussion is invited, to be received by W. L. Butcher, Editor, 715 Tremont Temple, Boston, before April 10, 1919, for publication in a subsequent number of the Journal.

been a real hardship and undoubtedly would have affected the health and morale of these embryo soldiers. After a period of six months' scientific training, men were developed to an extent permitting active work in the field without hardship or ill effect.

Much has been written about the construction of all the camps, Devens receiving its share, but only after a year of operation does one realize how wonderfully well the hasty plans and construction have served the purpose for which the camps were intended. The location has proved fortunate, is fairly easy of access to the city of Boston, about thirty-seven miles distant, with sand and gravel soil, although rather broken terrain, good water and natural sand-filter sewage disposal, ample railroad facilities, and, also of importance, land of low commercial value.

The entire Reservation contains about 10 000 acres, of which about 2 000 is occupied by the camp proper.

Originally, buildings to accommodate an entire company of 200 men, with kitchen and messing facilities, were designed, but a slight increase in the allotment from 40 to 50 sq. ft. per man, and an increase of the size of the companies, reduced the capacity of the buildings to 150 men each, necessitating construction of overflow barracks. The typical plan provides a two-story frame building, size 43 x 140 ft., including kitchen and mess hall with chestnut foundation posts, novelty siding, square-edged board roof covered with two-ply rubberoid and the interior lined with wall-board.

In general the barracks have proved satisfactory when the floor loads have been equally distributed, although the cost of maintenance and repair of buildings of this type has naturally been high. There are, of course, buildings of many other types, such as officers' quarters, small detachment buildings, storehouses, etc., all of which are one-story, but, instead of novelty siding, are covered with tar paper with battens.

Each company, detachment, or officers' quarters is provided with a lavatory 20 ft. distant from the barracks and provided with ample toilet and bathing facilities. The lavatory serving each 150-man barracks contains 12 flush bowls, 20 shower heads, urinal troughs, and hot water for bathing is continuously

furnished, the officers' quarters and the few small detachment buildings having smaller lavatories, to suit the requirements of the occupants. In the small section which is not heated by steam, hot-water heaters are provided in the lavatories. The camp contains 15 central heating plants, 44 individual heating plants, 360 lavatories, 98 buildings for officers' quarters, 277 barracks for enlisted men, a bakery, a post-office, a refrigerating plant, a laundry, 3 pumping stations, 1 substation, 4 fire stations, 2 grain elevators, one being located at the remount station, an incinerator plant, 25 medical infirmaries, numerous schoolhouses and many large buildings devoted to recreational purposes. Attached to the camp is a complete base hospital of 1 840 beds, which are placed in large wards, 33 of which are one-story, being ordinarily 24 ft. wide and approximately 150 ft. long; and 12 two-story convalescent wards, which in size are 24 ft. by 156 ft. Six large nurses' quarters are provided, a chapel and mortuary. A remount station, for 6 000 animals, is attached to the camp and contains barracks for its personnel, corrals, hay sheds, shelters, etc.

Soon after the arrival of troops it became quite evident that the operation of the various utilities and maintenance and repair of the camp required a well-organized force. Authorization was received, and after rather strenuous efforts on the part of the lone officer placed in charge, some semblance of an organization was formed by transferring soldiers from the line companies to the Camp Utilities Detachment, but it was not until January 1, 1918, that any serious attempt could be made to follow a rather hastily formed operating plan. The organization, however, proved its efficiency last winter when the slogan of "continuous service" was justified, although it must be confessed that a winter of extremely low temperature, resulting in frost over five feet in depth, frequently caused consternation. The officers, with few exceptions, were promoted from the enlisted personnel, and at present the commissioned personnel consists of the following:

Major Edward W. Briggs, officer in charge; 1st Lieut. Avery R. Schiller, executive officer and in charge electrical distribution; 1st Lieut. Edward C. Oldhan, in charge of electrical

operation and survey officer; 1st Lieut. James H. Reynolds, in charge of water and sewers and transportation; 2d Lieut. Edwin H. Burkhardt, in charge of plumbing; 1st Lieut. John V. Boyle, in charge of buildings and roads; 2d Lieut. Adolph J. Post, road engineer; 1st Lieut. Francis Cunningham, in charge of heating and post exchange; 2d Lieut. James L. Bride, assistant officer in charge of heating and adjutant; 2d Lieut. John M. Harrington, fire chief; Capt. Walter E. Brown, in charge of property and supplies.

In addition to the ordinary duties of operation, each officer is responsible for his share of the company administration, such as clothing, mess, discipline, etc., for the enlisted force of 850 men.

By comparing the camp with a city of 40 000 population, some idea may be had of the difficulties encountered in furnishing, not only ordinary water, sewer and lighting services, but delivering continually hot water for bathing, steam heat for buildings, electric lights, and at the same time keeping buildings and systems in repair. It is amazing how quickly a $1\frac{1}{8}$-in. hard-pine stair tread can disappear when used by 150 husky young men shod with hobnail shoes.

Careful consideration at the time of organizing the force was given not only to the operation of utilities, but also to the maintenance and repair which was expected to be high owing to the type of buildings and the number of occupants. With very few changes, after a year of operating, the organization stands as originally conceived, and consists of the following sections which function through the executive office to the officer in charge: Light and power, heating, buildings and roads, water and sewers, executive and engineering, purchases and contracts, property and supplies, personnel, fire protection.

Plate I shows the detail of the organization, but the officers and men listed on the organization chart are considered the maximum number which would be required under any conditions. This organization has operated with considerable success with 11 officers and about 850 men, although the work could have been performed more efficiently and with less responsibility on officers had it been possible to secure an organization

PLATE I
JOURNAL BOSTON SOCIETY
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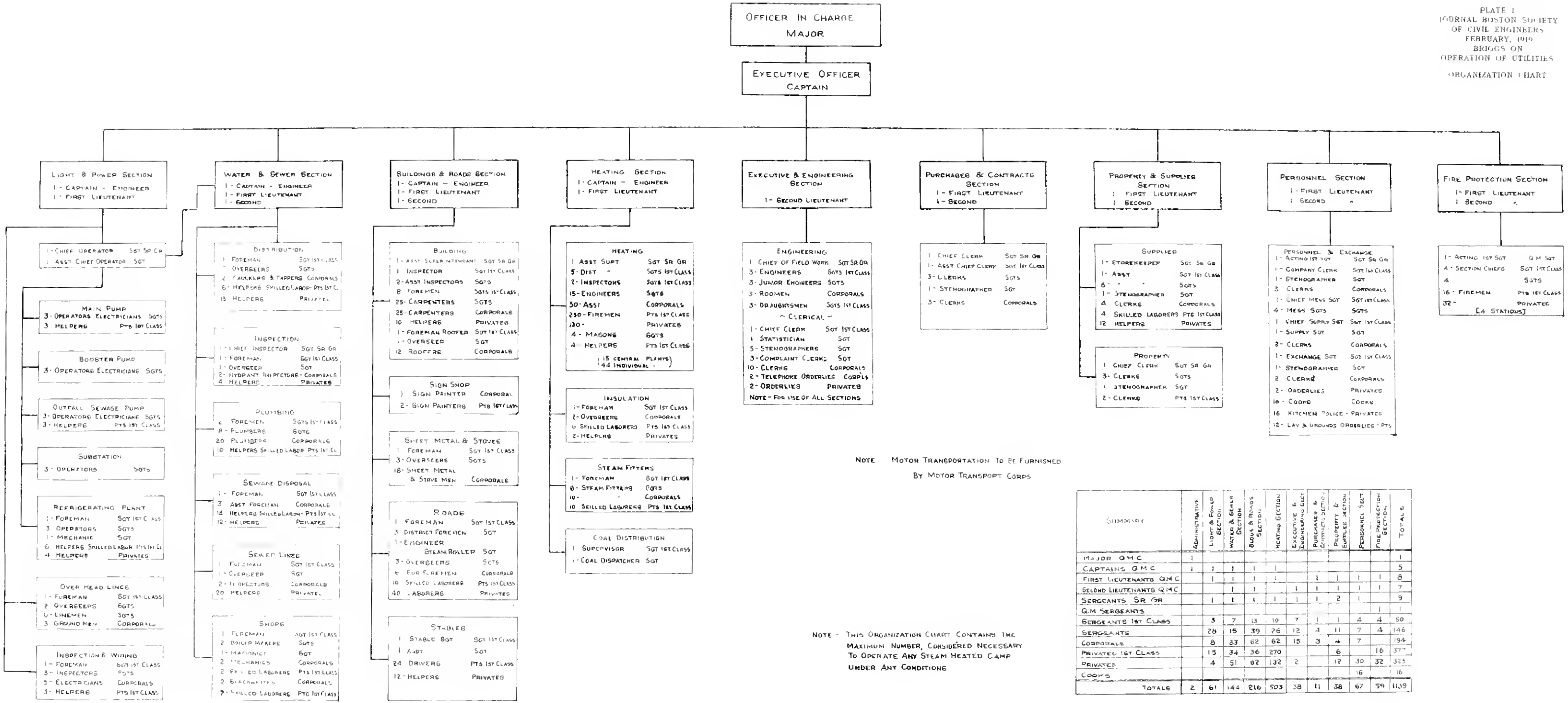
BRIGGS ON
OPERATION OF UTILITIES

ORGANIZATION CHART



Note Motor Transportation To Be Furnished By Motor Transport Corps

Note - This Organization Chart Contains The Maximum Number, Considered Necessary To Operate Any Steam Heated Camp Under Any Conditions

Summary	Administrative	Light & Power Section	Water & Sewer Section	Bldgs & Roads Section	Heating Section	Executive & Engineering Sect	Purchases & Contracts Section	Property & Supplies Section	Personnel Sect	Fire Protection Section	Totals
Major QMC	1										1
Captains QMC	1	1	1	1	1						5
First Lieutenants QMC		1	1	1	1		1	1	1	1	8
Second Lieutenants QMC			1	1		1	1	1	1	1	7
Sergeants Sr Gr		1	1	1	1	1	1	2	1		9
Q.M. Sergeants										1	1
Sergeants 1st Class		3	7	13	10	7	1	1	4	4	50
Sergeants		28	15	39	26	12	4	11	7	4	146
Corporals		8	23	62	62	15	3	4	7		194
Privates 1st Class		15	34	36	270			6		16	377
Privates		4	51	62	132	2		12	30	32	325
Cooks									16		16
Totals	2	61	144	216	503	38	11	38	67	59	1139

of about 15 officers and 1 000 men. Unless great care is taken by the officer in charge, the details of the work, which are enormous, will prevent his proper supervision of the whole, and in selecting section chiefs careful consideration was given not only to technical training and experience but also to personality. It has been an unwritten law that, while the officer in charge would keep himself in touch with the organization and its work at all times by means of detailed monthly reports from each section, yet only such problems would be presented as could not be handled to advantage by the section chiefs.

Discipline in the military service is necessary, but thorough coöperation must also be secured, not only by the officers and men within the organization, but with all units in camp; and the problems presenting themselves furnished the officer in charge with many anxious moments. Any success that has been met was entirely due to the loyalty and unselfish support of the officers and men. The great advantage gained in use of soldier labor is that the officer in charge has absolute knowledge and control of his men at all times, permitting the handling of emergencies with great dispatch.

On the organization chart a tie will be noticed between the Light and Power Section and the Water and Sewer Section, which is necessary as the pumps are electrically driven and are operated by the Light and Power Section for the Water and Sewer Section, which, however, designates the time of operation. No difficulty or friction of any nature has developed from this slight dual responsibility.

Light and Power Section.

For convenience of operation, this section has been divided into Operating and Distribution, with a commissioned officer in charge of each.

Under the supervision of the former are the substation, the operation of the main pumping station and outfall sewage pumping station, booster fire pump station and refrigerating plant. Under the supervision of the latter are the electrical distribution feeders, secondary lines and all matters pertaining to the utilization of electricity.

The principal assistant of the officer in charge of electrical operation is a senior grade sergeant who is directly responsible for all field work of his department. This man's duties keep him continually in the field, and his task is to supervise and keep his chief informed of all activities in the various stations. Under his direction are the shift operators and helpers who stand watch in the different operating plants.

The Transformer Station is located on the northern edge of the camp near the main entrance, and from this point light and power is distributed to all parts of the cantonment.

Electric current for this camp is furnished by the New England Power Company, a hydroelectric property with steam standby, whose nearest generating station is at Vernon, Vt., sixty miles from Ayer. The nearest point on the transmission line was at Leominster, Mass., 8.4 miles distant, and it was necessary to build a branch line from that station. This branch consists of two separate wooden pole lines on private right-of-way. Each line transmits at 66 000 volts, 3-phase, and is composed of 3 No. 2 stranded copper conductors. There are 243 poles for each line, using steel wishbone-arms and 4-disk insulators except at corners, railroad crossings and dead-ends, where two-pole structure with steel angle-arms and 5-disk insulators are employed. A private telephone line is strung on one of the lines, giving direct communication with the various substations, generating stations and load dispatcher's office of the power system. Each transmission line terminates in the substation yard at a two-pole structure.

All high-tension equipment is of outdoor type except the transformers, which are housed in an asbestos-covered corrugated-metal building, 13 ft. by 26 ft. The high-tension apparatus consists of two K-26, 70 000-volt, triple-pole, single-throw, automatic-trip oil switches provided with bushing-type current transformers; one set of 70 000-volt electrolytic lightning arresters, outdoor 66 000-bolt metering outfit containing current and potential transformers, watt-hour meter and a graphic demand meter. A set of 5-disk suspension-type disconnecting switches is provided on each side of each oil switch and also on the line to the lightning arrester. The two transmission lines are paral-

leled through a high-tension bus from which a single line leads into the transformer house, first going through the metering outfit. The bank of transformers consists of three oil-insulated, water-cooled, single-phase, 66 000–2 200-volt, 500-k. v. a. transformers. Two 5 per cent. taps are provided on the high side, and the transformers will carry 750 k. v. a. each for two houses with 55 degrees rise. Cooling water is obtained from the camp supply. Each transformer is connected through a 2-in. pipe line to an oil storage tank outside of the building to permit draining of the oil, which may be pumped back through a filter.

From the 2 200-volt delta, three 300 000-C. M. slow-burning cables extend into the substation, which is about 15 ft. from the transformer house. The substation is a brick building 22 ft. by 30 ft. and contains the low-tension switchboard. The switchboard consists of ten black slate feeder panels and one bus panel. Each feeder panel is equipped with an indicating ammeter, selective ammeter switch, two 100-amp. current transformers and a manually operated triple-pole, single-throw, 300-amp., 4 500-volt oil switch provided with two time-limit automatic overload trip coils. The bus switch panel is provided with indicating ammeter, voltmeter and wattmeter, ground detector and an 800-amp. oil switch; 3-in. by $\frac{1}{8}$-in. copper busses extend the full length of the board, with taps to each feeder switch. Induction-type, overload, time-limit relays and reverse-power relays connected to the bushing transformers in the 66 000-volt oil switches are also mounted on the board. The high-tension switches are automatically tripped by a 12-volt storage battery and are closed by hand.

Each feeder is run through conduit from the board to choke coils and disconnect switches mounted on the wall, 3-conductor, No. 1, B. & S. gage, lead-covered cable being used. From the choke coils the lines pass through entrance bushings to the 6-pole structure outside, from which the circuits extend to all parts of the camp. Each circuit is protected by Type C-R lightning arresters.

The station is operated by a force of three enlisted men with grade of sergeant, working on eight-hour shifts. These men all had similar experience on high-tension stations before

entering the service. The yard is surrounded by a high board fence, guarded at all times and well lighted at night.

The average monthly kw. hr., used during the fourteen months ending October 31, 1918, was 343 000, with a maximum of 446 000 for October, 1918, and minimum of 267 000 for July, 1918. The monthly power load varies between 120,000 and 160,000 kw. hr., the remainder being lighting load. Two typical daily load curves are shown for winter and summer months, each curve being the average daily load taken for one week. Figs. 1 and 2.

Main Pumping Station.

The main pumping station is located about 2½ miles from the substation.

A two-stage, 8-in. volute pump, 2 000 000 gals. per day, 250-ft. head, direct connected to a 440-volt ,3-phase ,150-h.p., 1 800 rev. per min., squirrel-cage induction motor.

A four-stage, 10-in. turbine pump, 2 000 000 gals. per day, 250-ft. head, belt driven by a 550-volt, 3-phase, 250-h.p., 600 rev. per min., phase-wound induction motor.

A two-stage, 8-in. volute pump, 2 000 000 gals. per day, 250-ft. head, direct connected to a 2 200-volt, 3-phase, 150-h.p., 1 800 rev. per min., squirrel-cage induction motor. A bank of 3 100-k. v. a. transformers step down the voltage from 2 220 to 440 and 550 volts.

Other equipment consists of one switchboard panel, two oil switches, watt-hour meter and the necessary starting compensators. All water pumped is measured by a 3 000 000 gals. per day Venturi meter provided with indicating, integrating and graphic dials.

The operating force consists of three sergeants and three first-class privates, working on eight-hour shifts.

Sewage Station.

The sewage pumping station contains one pumping unit which pumps all the camp sewage to the filter beds. This unit consists of a 10-in., single-stage centrifugal pump, 2 800 gals. per min., 655 rev. per min., 80-ft. head, belt driven by a 2 200-volt, 100-h.p., 3-phase, 1.200 rev. per min., squirrel-cage induction

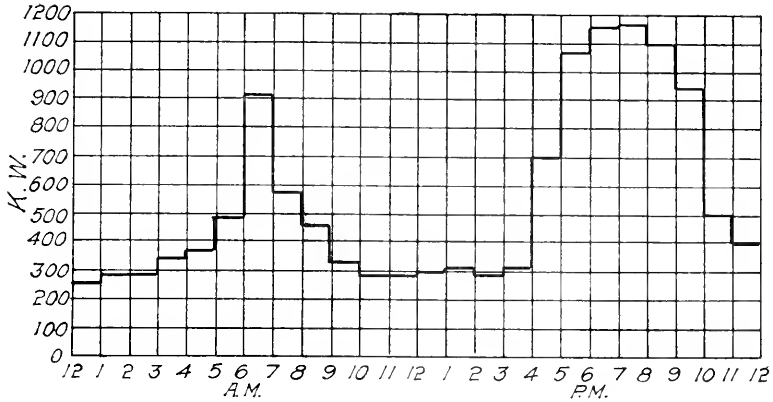


FIG. 1. TYPICAL DAILY LOAD CURVE.

Week January 15–21, 1918, average daily kw. hours, 13 100; maximum daily kw. hours, 14 400; maximum hour 1 500 kw. January 17, 7–8 P.M. Load factor for week, 42.0 per cent.

Month of January, 1918, total kw. hours, 410 900; average daily kw. hours, 13 250; maximum daily kw. hours, 14 400, January 17; minimum daily kw. hours, 11 400, January 26; maximum hour, 1 500, January 13, 14 and 17.

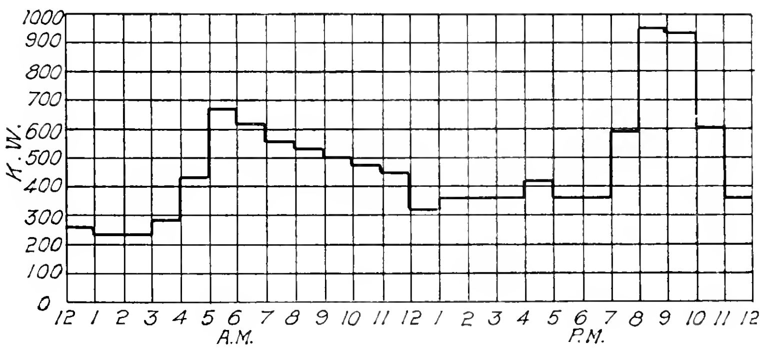


FIG. 2. TYPICAL DAILY LOAD CURVE.

Week, August 16–22, 1918, average daily kw. hours, 11 157; maximum daily kw. hours, 12 200; maximum hour, 1 200. Load factor for week, 47.1 per cent.

Month of August, 1918, total kw. hours, 357 700; average daily kw. hours, 11 530; maximum daily kw. hours, 14 400; minimum daily kw. hours, 8 700; maximum hour, 1 300.

motor. Sewage flows by gravity into a concrete well, 61.5 ft. diam., 8.16 ft. deep, located at the pumping station, from which reservoir it is pumped to the filter beds. The pump is self-priming when the well is full and the average pumpage per day is about 1 200 000 gals., requiring actual operation of about seven or eight hours. The time the pump is running is divided into three or four periods during the day, depending upon the rate of flow. Three sergeants comprise the operating force.

Booster Station.

This station is located at the water tanks on the highest elevation in camp, and the pump here is used to increase the pressure in the mains in case of serious fires. The pump suction and discharge lines are shunted from the main and controlled by gate valves. This pump is a 10-in. volute centrifugal, 2 000 gals. per min., 60-ft. head, direct connected to a 2 220-volt, 50-h.p., 3-phase, 60-cycle, 900 rev. per min., squirrel-cage motor.

Three sergeants, operators, are in charge. Each hour the height of water in the tanks is telephoned to the main pumping station and the rate of pumping regulated accordingly.

Refrigerating Plant.

The camp refrigerating plant is a building 64 ft. by 101 ft., containing a compressor and freezing room, ice-storage room, butter and egg cooler, provision cooler, beef cooler and office. The total cooling room volume is 48 000 cu. ft., and the rooms are cooled by brine circulation.

The operating-room equipment consists of two horizontal, single-cylinder, double-acting, $9\frac{1}{2}$-in. by 18-in. compressors, each belt driven by a 2 200-volt, 3-phase, 50-h.p., phase-wound induction motor; one 150 gals. per min. circulating water pump, two circulating brine pumps and brine agitator, each driven by a 220-volt, 3-phase motor.

Freezing tanks of 160 cans each capacity are installed. The blocks of ice are 300 lbs. each. Each tank is provided with a traveling crane and one ice dump. An individual boiler plant furnishes heat for the compressor room and warm water for the ice dumps. The ammonia condenser is mounted on the roof, and cooling water circulated through a cooling tower located

beside the plant. During the hottest weather of the past summer 25 tons of ice were made daily in addition to a refrigerating duty of ten tons.

The total operating force consists of 1 chief operator (sergeant first class), 3 operators (sergeants), 1 mechanic (sergeant) and ten helpers (privates) working eight-hour shifts.

During a year of operation, no difficulties of any nature have been encountered in the various units, and only one interruption in service on the transmission lines, which caused no damage.

Distribution.

Under the officer in charge of distribution are two first-class sergeant foremen, one in charge of line work and the other in charge of interior wiring. The line foreman has, under his supervision, linemen, groundmen and chauffeurs, and the inside foreman has inspectors, electricians, chauffeurs and helpers.

The electrical distribution system is entirely carried on wooden pole lines with poles varying from 25 ft. to 45 ft. in height. From the substation eight 3-phase, 2 200-volt, 60-cycle feeders enter camp by two different routes, each of which carries four circuits. A ninth circuit of similar characteristics to the above runs from the substation to the remount depot, some three miles from the camp proper.

In line construction work, N. E. L. A. specifications have been adhered to throughout. Joint construction with the New England Telephone and Telegraph Company has been the practice on government-owned poles although the telephone company installs, operates and maintains its own plant.

In the distribution system there are approximately 1 625 Class B, N. E. L. A. specification, chestnut poles, which constitute approximately 38 miles of pole line. There are 171 miles of primary and secondary wiring; a series street lighting system of 315 lights fed in four separate circuits from General Electric Company, Type R. O., pole type, constant current transformers. These street-light circuits are 6.6. amps. and the lamps are 100 candle-power Mazda C. There are 173 distribution transformers on the system, varying in size from 1 k. v. a. to 100 k. v. a., the total capacity of transformers connected being 2 340 k. v. a.

Practically all transformers are protected by Westinghouse Type C-R lightning arresters. That this protection has been very effective is proven by the fact that, in spite of many severe electrical storms in this vicinity during the summer just passed, but two transformers were damaged by lightning, and both of these were transformers which were not protected by arresters within five sections of the transformer.

The main feeder circuits enter camp by two different routes. In these circuits at intervals are installed 200-amp., 4 500-volt, 3-pole, single-throw, pole-type oil switches. These switches are used not only as sectionalizing switches but also as tie switches between different circuits on the same pole. With this switching arrangement it is not only possible to sectionalize all trouble and districts in time of fire and other emergencies, but also to feed each circuit temporarily from one or more circuits in time of need.

The typical secondary distribution system for four barracks consists of 2-20 k. v. a. transformers with secondaries banked and connected on the secondary side for 110-220 volts. All services for connected lights of 1 200 watts or less are 2-wire 110 volts, and for over 1 200 watts, 3-wire 110-220 volts.

Of the interior wiring, there are approximately 38 000 outlets in camp, the majority of which are filled with 40-watt, Mazda B lamps. There are 364 miles of interior wiring which is practically all knob and tube work.

The problems which confronted the electric distribution department at its inception were many, and considerable difficulty was experienced in obtaining suitable linemen. Later, when the camp was fully inhabited and the different organizations started improving their parade grounds, a great many light and power poles were dug out of the ground. Replacing these occupied a considerable part of the early activities of the department.

It has been the practice to have a trouble man on duty each evening until 10 P.M., to investigate, and whenever possible remedy, all line troubles. Where the job demanded increased help, the rest of the line crew was turned out.

During the winter of 1917–18, which was extremely severe, the electrical department constructed a pipe-thawing outfit

which rendered impressive service in freeing frozen water services and pipes. With but one exception all frozen pipes were relieved by this apparatus the same day as reported, which fact was the cause of much favorable comment when compared with the numerous stoppages which were reported by surrounding New England towns and cities.

This thawing outfit consisted of 4-10 k. v. a. transformers mounted on a wagon bed. These were connected in sets of two on the primary side with the primary winding of each pair in series, making the impressed voltage on each winding 1 100 volts. Secondaries were connected with all coils in multiple and all banked into the low voltage bus of the apparatus. The time required to free pipe lines with this outfit varied from three to twenty-two minutes, depending on the size of the pipe and length of run.

In the utilization of electricity the problems to be dealt with were almost diametrically opposed to those usually met with in the operation of public service companies. In the average utility, the electric company is continually striving to build up the load. Here, the effort has been to keep the load down. Each barracks, storehouse, etc., had installed in it a prescribed number of lights which had been determined upon as adequate for the necessary illumination of the buildings. When the barracks were occupied by the various organizations, many changes were attempted, and as the wiring in the buildings is practically all exposed, it was but a short time before a great number of unauthorized lights began to make their appearance, usually being put up in an unworkmanlike and hazardous manner with telephone wire and annunciator wire, etc., and on this account, as well as because of the fact that these added lights threatened a serious overload on the system, it very quickly became apparent that an effective means of control was necessary. As a corrective, instructions were given by the commanding general that no extensions or appliances should be allowed without a permit from the officer in charge of utilities. Frequent inspections are made of all buildings, which has to a great extent permitted control of the situation.

The normal average per capita kw. hr. consumption for the camp for all purposes, including lighting, water supply, sewage disposal, refrigeration and many smaller and miscellaneous power installations, has been 8.7 kw. hr. per month, or 105 kw. hr. per annum.

The general installation was good, but it has been found necessary to make many changes and additions to house and storehouse systems, which however is not surprising when consideration is given to the short time available in planning the camp. Too much emphasis cannot be given to the necessity for frequent and rigid inspections of all inside wiring.

Heating Section.

The heating section is headed by a commissioned officer and a commissioned assistant. For convenience in this section, the camp has been divided into districts, known as the Base Hospital, the Infantry and the Artillery.

The Base Hospital is supplied by a plant of 12 H. R. T. boilers rated at 150 h.p. each, and an auxiliary plant is under construction, having 4 H. R. T. boilers rated at 150 h.p. each.

The Infantry Section is supplied from 10 central heating plants, each of which contains 10 cast-iron sectional boilers, 30 of which are rated at 9 375 square feet and 70 of which are rated at 9 175 sq. ft.

The Artillery Section is supplied from 3 plants, each having 7 cast-iron sectional boilers rated at 9 000 sq. ft.

Some comment has been occasioned by the use of cast-iron sectional boilers, but it is understood that a shortage of tubular boilers existed when the type was designated. In operating, however, no serious obstacle has been met, and all the plants, both tubular and cast-iron, have given uniform satisfaction, although the haste with which they were installed made corrections necessary, which will be mentioned later, but on which no criticism is justified. It should be understood that steam heat for the buildings was not seriously considered until the construction of the camp was well along.

Steam is distributed from the boiler houses to the various buildings served, through mains carried overhead on poles and

insulated by seaweed quilting (two thicknesses), all wrapped in 2-ply rubberoid paper which is fastened with large-sized marlin. Originally no return systems were provided for any of the central heating plants, but after four months of operation estimates were prepared for all plants individually, which indicated that the net earnings on the investment, after all fixed charges were considered, proved to average 6.1 per cent. for the Infantry and Artillery sections and 13.5 per cent. for the Base Hospital; the latter was very promptly authorized and is now in operation.

The individual heating plants all have cast-iron boilers ranging from 3 to 150 h.p. in capacity, with the exception of the laundry plant now under construction, which is to have two 150-h.p. H. R. T. boilers. Of the individual plants, two are equipped with four boilers.

The following figures will give some idea of the service provided in this section:

a. Number of buildings heated by steam, 718.
b. Number of latrines furnished with hot water, 264.
c. Cubical contents of buildings heated by steam, 30 854 290 cu. ft.
d. Square feet of floor area in buildings heated by steam, 3 080 329 sq. ft.
e. Number of miles of steam piping in camp, 80 miles.
f. Square feet of radiation in radiators or pipe coils, 808 540 sq. ft.
g. Number of radiator sections equivalent to 808 540 sq. ft., 161 708.
h. Square feet of covered piping exposed to outside temperatures, 55 442 sq. ft.
i. Number of traps in service, 2 000.
j. Number of boilers, 183.
k. Total horse-power, 11 627 h. p.
l. Maximum daily coal consumption, 445 tons.
m. Maximum daily evaporation, 800 000 gals.
n. Daily use of hot water at 100 degrees temperature in latrines, 43 800 gals.

From the above general figures it is interesting to give a few figures per unit:

a. With an average temperature for the month of February, 1918, of 21 degrees, the coal burned per man, per day, is 23.7 lbs. Based on full capacity of the camp, the figure becomes 16.9 lbs.

b. Based on February, the coal burned per day, per sq. ft. of floor area, is 0.0206 lb.

c. Also based on February, the coal burned per day, per cubic foot of building, is 0.0206 lb.

d. The water evaporated per man, per day, for the month of February is 21.3 gals. Based on camp at full capacity, this figure becomes 15.2 gals.

e. Hot water at 100 degrees used per man, per day, is 1.25 gals.

The Heating Section is divided into two departments, — operating and maintenance. The former is divided into four districts with a sergeant first class in each acting as district superintendent. All plants are operated by three shifts of eight hours each, and each central heating plant is in charge of a sergeant, acting as engineer, each shift having a corporal in charge.

In general, it has been considered that one fireman, all of whom are privates first class, can serve two boilers. No storage space is available in the houses, nor are bins provided outside, which increases the coal passers and ash wheelers considerably beyond the number ordinarily required in usual civilian practice. It has been the experience at this camp that four are needed in each watch.

The individual plants, 44 in number, are scattered, and it has been found necessary to use fifty men on this work, which is in charge of a sergeant first class, acting as superintendent of individual plants, assisted by three sergeants. Considerable difficulty has been experienced in successful operation of the very small plants, which require constant attention.

Shortly after the plants were installed, test was made in one of the infantry boiler houses, which showed that the evaporation was 5.5 lbs. water evaporated per pound of fuel placed in the fire boxes. The flue gas temperatures were above 800 degrees Fahr. At this time conditions were unfavorable, the firemen were still experimenting with drafts, cleaning fires and generally becoming familiar with their duties. Gradual corrections were made to raise the efficiency of all the plants, draft conditions were studied, thickness of the fire varied to meet the draft available at the different plants. The fires ranged in thickness from 8 to 12 ins. Fires had been cleaned too frequently, and the period was gradually increased until it became once

in two days. Shaking down fires became more frequent until twice in a watch proved more satisfactory. Becoming familiar with the type of boilers and the best draft and fire conditions raised the evaporation from the test figure of 5.5 lbs. to 6.8 lbs., or a coal saving of 23.8 per cent. As a further economical measure and to reduce the flue gas temperatures, the grate surfaces were cut down one third. It was found that in order to run this type of boiler at capacity or slightly above, there was not enough combustion space for the grate area, thus causing combustion to take place in the larger area provided for the flues. This reduction in the grate area raised the evaporation to 7.5 lbs., thus reducing the coal 12.7 per cent. more, giving 68.5 per cent. boiler efficiency and a total saving in coal from the first test of 36.5 per cent. The evaporation for the 13 central heating plants, using cast-iron sectional boilers and containing a total of 121 boilers, reads as follows:

February	7.5 lbs.
March	7.48 lbs.
April	7.48 lbs.

NOTE.— 7.5 lbs. evaporation is equivalent to 69.5% boiler efficiency.

At the Base Hospital, two boilers were not installed until early this spring (1918) and during the severe weather the plant operated with 10 H. R. T. boilers, rated at 150 h.p. each, with a 25 per cent. over-load during the months of January and February. Anthracite coal had been furnished as fuel, bituminous not being available. This was the last plant to be constructed and was built under extremely unfavorable conditions, — fire boxes and brick work being put up and soaked with rain before the building was roofed. Arch and cheek plates were burned, dead plates cracked, and the back arches, which were of T-iron unprotected by fire brick, fell in from the hot gases from the combustion chamber. Fortunately this condition did not become serious until after the severe weather had passed, all of which has been corrected and replaced with first-class material and workmanship. By introduction of bituminous coal at this plant, there was a saving of 15 per cent. in the consumption and 27 per cent. in the cost of producing steam. Anthracite coal of

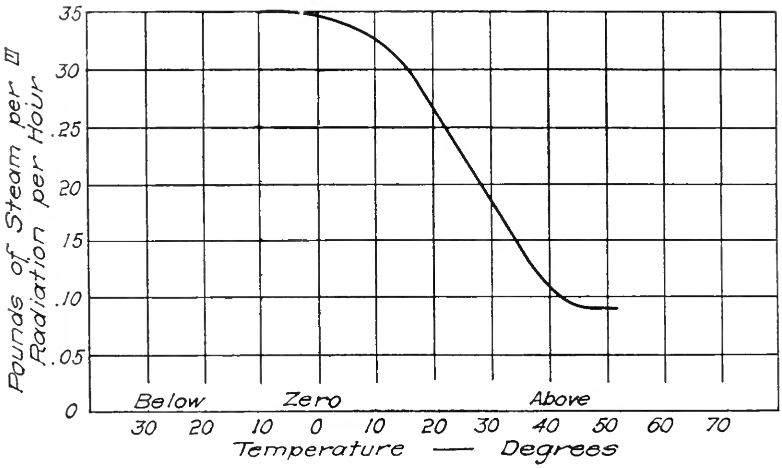


FIG. 3. POUNDS OF STEAM PER SQ. FT. OF RADIATION PER HOUR. Plot, 17 weeks, 3 days. Boiler houses, 2–14.

good quality was used in the cast-iron sectional boilers with entire satisfaction. Water evaporation of all the central heating plants for the first four months of 1918 reads as follows:

WATER EVAPORATION.

Month.	Daily Average Evaporation. Gallons.	Average Temperature.
January	676 000	13 degrees above
February	491 500	21 degrees above
March	343 000	35 degrees above
April	242 500	47 degrees above

Twenty-four-hour max., 728 900.

COAL CONSUMPTION.

Month.	Month Tons.	Daily Ave.	Estimated.	Percentage under Estimate.
January	12 486	403	533	19.3
February	8 217	293	461	36.4
March	6 099	197	318	28.1
April	4 053	135	248	45.5

Twenty-four-hour max., 414.

Grate surfaces were not all cut down until the middle of February, although the work was started in December, some difficulty being experienced in securing the necessary material, and also lack of men caused some hindrance. During January

the average temperature was 13 degrees, and the minimum 35 degrees, below zero; average temperature for one week was 2 degrees below zero, in spite of which the coal consumed was 19 per cent. under the estimate.

During construction, which was rushed with all possible speed, difficulty was encountered in securing labor familiar with setting cast-iron boilers, with the result that a few sections and many nipples between sections were cracked, causing an average of one boiler in each plant to be out of service entirely and others to leak more or less. With one boiler out of service, the capacity of the plants was cut down 10 per cent., and when zero temperature existed the boilers in service were operating at rating, but no over-loads were possible. The following table shows the relation between radiation and capacity of the plants, No. 1 being the Base Hospital:

B. H. No.	Radiation. Sq. Ft.	Boiler Rating 0° Temperature.	Radiation in Per Cent. of Boiler Rating at 0° Temp.	Radiation in Per Cent. of Boiler Rating at 0° Temp. with 1 B. down.	B. H. P.
1	154 754	124 800	124.0	153.0	1 500
2	53 570	58 350	91.6	101.8	665
3	51 223	59 600	86.0	95.5	678
4	53 762	59 600	90.2	100.0	678
5	47 259	58 350	81.1	90.0	665
6	49 633	58 350	84.7	94.2	665
7	51 870	58 350	89.0	99.0	665
8	49 424	58 350	84.8	94.2	665
9	53 721	58 350	92.0	102.0	665
10	50 060	58 350	85.8	95.5	665
11	50 045	59 600	83.8	93.2	678
12	34 513	41 600	82.9	97.0	475
13	32 901	41 600	80.7	94.2	475
14	32 241	39 100	85.0	99.3	457
Totals	765 776	834 350			9 596

In the curve plotted (Fig. 3) to show the variation in pounds of steam per square foot of radiation, outside lines and inside covered mains are included, with due allowances for outside temperature, inside temperature and the efficiency of the covering, besides the equivalent direct heating surfaces in the coils in the hot-water tanks.

Permanent bridge walls have been placed in the boilers to cut down the grate area and covering replaced where boilers were torn down. All outside distribution mains were placed in first-class order and have been painted. All stacks have been painted. The total cost of repairs to the boiler plants was 1.6 per cent. of the first cost. There are 2 000 traps which require continual care, and if not inspected at least twice daily will clog, freeze, or both, due to the installation of radiators in series, so that when the loading valve is shut circulation ceases. In spite of the care and attention necessary, no change in the system is recommended. Trouble has been experienced from men in the barracks opening and closing valves, including the main throttle valves in the buildings, which was overcome to a considerable extent, however, by sealing the throttle valves. During the summer one boiler in each plant is operated for hot water at about 66 per cent. of rating. At the Base Hospital one boiler carried cooking, sterilizing, hot water, laundry, etc., at 60 per cent. of rating. Twenty-four-hour service has been provided with a heating system which was original in many ways, but which on the whole has proved satisfactory.

Maintenance.

The Maintenance Department does all steam repair work, insulation and mason work, which is in charge of a sergeant first class. The operating and maintenance forces work in harmony, and small jobs, such as cleaning traps, are done by the men from each boiler house who are out on distribution mains and in the barracks inspecting traps.

The question has been asked many times as to the value of the central heating plant system over the individual plants for each barracks, or the use of room heaters. Experience here indicates central heating plants preferable from every viewpoint.

Buildings and Roads.

Buildings.

This section is in charge of a commissioned officer, who, however, should have two commissioned assistants; one for buildings and one for roads. The Building Department has a sergeant first class acting as superintendent, 6 carpenter foremen

(sergeants), 24 carpenters (privates), a sheet-metal and stove-repair shop with a foreman (sergeant first class) in charge, and 12 privates.

The problems in this section are practically all of maintenance, very little new construction being attempted. The buildings, as indicated heretofore, are of only semi-permanent type, the entire camp having been designed for a service of from five to ten years. While the buildings will safely carry the load distributed as planned, unwise congestion, until corrected, caused some apprehension. For instance, the first-floor squad room, intended for dormitory purposes, was frequently converted into a recreation room, with piano, billiard tables, etc., causing an over-load on the second floor, and a concentrated load on the first. In some instances, supporting columns were removed. Continual and rigid inspection of all buildings is necessary. The amount of repairs necessary is naturally high, the roofs perhaps requiring the most attention.

It has been found that the green square-edge roofing boards have curled in seasoning and pushed through the two-ply rubberoid paper; and in future construction it is believed that matched boards should be used, placed vertically, and roofing paper strips laid vertically instead of horizontally. The increased cost should not be excessive. Heavy snowfalls were experienced last winter, and, in spite of all attempts at control, men with hob-nailed shoes, using iron shovels, were allowed on the roof to remove the snow, causing many leaks; one building having over one hundred in one week. An increased pitch to the roof, it is believed, would to a great extent overcome this condition. Buildings have sagged to some extent, but are promptly jacked up. The life of stair treads, which are of $1\frac{1}{8}$-in. hard pine, is about four months when the barrack is continuously occupied.

About 600 stoves and ranges of numerous makes are in camp, the repair of which requires a considerable force and much material. The camp has accommodations for approximately a population of 37 000, which a great portion of the time has been exceeded, reaching as high as 47 000. During the summer several thousand were housed under canvas, but as the majority so provided for were attached to barracks for mess, the additional

use of the cooking ranges was noticeable in the unusual amount of repairs necessary. The galvanized iron stacks and sheet metal in the lavatories need constant repair. The number of repair jobs increases each month, with increasing attention necessary.

From January 1 to November 1, 1918, 10 255 repair jobs were completed, requiring 94 267 hours' labor, the following material being used:

Lumber	100 000 B.M.
Nails	154 kegs
Sheet metal	13 994 lbs.
Roofing paper	11 772 sq. ft.
Roofing compound	36 920 lbs.

Roads.

The road department has one sergeant first class, acting as superintendent, 3 district inspectors (sergeants), 6 foremen (sergeants) and 40 laborers (privates). The labor is increased during the summer by using the men from the heating plants.

The roads consist of three general types, — tar macadam, about 8 miles; gravel, 13 miles; and a small amount of concrete. The tar macadam is further separated into two sub-types, according to the kind of base used. In 1917 the base specified was a 6-in. layer of field stone laid similarly to a Telford foundation and bound by rolling in gravel. The source of material was the large number of stone walls then existing in the camp. In 1918 a 4-in. waterbound base was substituted for the field stone in the specifications, as the source of the latter had been entirely depleted. This base consisted of 6 ins. of egg-size stone rolled to 4 ins. and bound with dust. Upon these bases was laid the wearing surface of egg stone. This layer is 2 ins. thick when lightly rolled and penetrated with $1\frac{1}{2}$ gals. of Tarvia "X" per square yard. Pea stone is swept into the pores and the seal coat of $\frac{1}{2}$ gal. of Tarvia "X" per square yard is applied. This material is thrown on top, and, after rolling, the road is ready for traffic.

Only a small amount of concrete road has been built, such as entrances to fire stations, strips along loading platforms at the storehouses, etc. Gravel roads for the company streets,

serving the kitchen ends, have proved satisfactory, but are not recommended for other locations. Traffic is heavy, making necessary continual patching and building up of the shoulders. During the winter, roads are kept clean by using snowplows attached to three-ton motor trucks and animal-drawn plows.

From January 1 to November 1, 1918, 2 880 repair jobs were completed, requiring 125 778 hours' labor and using the following material:

Cement	3 431 bags
Tarvia "B"	10 715 gals.
Tarvia "X"	4 500 gals.
Tarvia "A"	4 500 gals.

Water and Sewer Section.

This section is subdivided into three departments, — *Water, Sewer and Plumbing*, in general charge of which is a commissioned officer with a commissioned assistant. In the *Water Division* are 2 inspectors (sergeants first class), 3 foremen (sergeants), 4 gang foremen (corporals), 34 laborers (privates). *Sewer Division*: 1 inspector (sergeant first class), 2 foremen (sergeants), 4 gang foremen (corporals), 25 laborers (privates). *Plumbing Division*: 2 inspectors (sergeants first class), 8 foremen (sergeants), 13 plumbers (corporals), 13 helpers (privates).

Water.

The source of supply is located near a pond about two miles from center of camp, originally consisting of one dug well 50 ft. in diameter, about 28 ft. deep, sunk in fine sand and having a capacity of approximately 2 000 000 gals. a day. Late in the fall of 1917 this supply proved inadequate, and an area of about one acre, located on a rise some 300 ft. from the well, was stripped of soil and used as an auxiliary filter for temporary relief of shortage. The water to supply this filter was pumped from the pond and percolated back to the well, increasing the supply approximately about 200 000 gals. a day. Unfortunately extremely severe weather was experienced early in the winter, the temperature dropping as low as 35 degrees below zero; and in spite of the fact that the discharge pump was operated

continually the suction and distributing lines froze solidly. By the time this difficulty was overcome, the pond had frozen solid to a considerable distance beyond the suction, preventing the use of the auxiliary supply, which caused a very acute shortage of water during the entire winter. In the spring of 1918, forty $2\frac{1}{2}$-in. tubular wells were driven along the shore of the pond, which yield approximately 1 000 000 gals. per day and are brought to the main dug well by siphonic action. Since this installation, ample supply has been available at all times.

The quality of the water is excellent both in appearance and chemically. Result of analysis made by the Massachusetts State Department of Health follows:

TAP AT PUMPING STATION.
Parts per 100 000

Turbidity, sediment, color	None
Odor, cold and hot	None
Residue on evaporation	7.00
Free ammonia	0.0012
Album. ammonia	.0032
Chlorine	.84
Nitrates	.0060
Nitrites	.0000
Hardness	3.3
Iron	.005

MAIN COLLECTING WELL ABOUT 8 INS. FROM SURFACE.
Parts per 100 000

Turbidity, sediment, color	None
Odor, cold	None
Odor, hot	Very faintly, bleach
Residue on evaporation	7.40
Free ammonia	.0006
Album. ammonia	.0034
Chlorine	1.30
Nitrates	.0000
Nitrites	.0000
Hardness	3.5
Iron	.015

A full description of all pumping units has been furnished under Light and Power Section.

Four storage tanks were originally constructed, 30 ft.

in diameter, 20 ft. in depth, combined capacity 400 000 gals., and are located adjacent to the booster pump, the highest area of the camp, on wooden trestles 26 ft. above the ground. The elevation of the bottom of the tanks is 407.33.

The distribution system consists of the following pipe:

12-inch	12 850 ft.
10-inch	7 820 ft.
8-inch	77 280 ft.
6-inch	16 000 ft.
4-inch	2 010 ft.
Service connections about	97 000 ft.
Total	212 960 ft.

There are two 12-in. mains leading into camp from pumping station. A double loop of 8-in. pipe parallels the two roads which encircle camp, one being, roughly, 150 ft. inside the outer road and the other being 30 ft. outside the inner road. These loops are brought together in two 10-in. lines to the tanks. Two 10-in. lines run from tanks to Hospital district, where another 8-in. loop encircles this group of buildings, which is intersected with 6-in. cross connections. The remount station, which is located about two miles from the center of the camp, is supplied through an 8-in. wood pipe line which crosses the central portion of camp, tying in the several loops connecting at the main from the village of Ayer at West Main Street and following the Nashua Valley to the remount station. The Ayer connection is gated and provided with meter. A 300 000-gals. supply could be obtained from Ayer in case of necessity. All pipe was originally laid a uniform depth of 5 ft. below the surface of the ground. However, much grading has been carried on by various units, necessitating the lowering of considerable pipe.

The camp is provided with 253 4-in. hydrants with independent gates opening to the left. The system has 140 gate valves, all of which open to the left, excepting 3 at main pumping station. All services are of galvanized iron, ranging from $\frac{3}{4}$ in. to 2 ins. in diameter. Each service is provided with a corporation cock at the main and a stop and waste valve about 5 ft. from building line to which service runs.

During the early spring, samples of water, which are taken daily, were found to contain a comparatively high amount of bacteria, produced by surface water entering the well, which defect was overcome. A temporary apparatus was built, introducing a solution of hypo into the well, but by fall, chlorinator apparatus with automatic control was installed, chlorine being introduced into section of pumps at the rate of .24 p.m.m., which was found sufficient to sterilize the water but leave no taste of chlorine. It has not been found necessary to operate the chlorinator continuously.

Practically all mains in the camp are of machine-banded Remco wood stave pipe, which has some advantages over iron pipe, in that it can be laid more rapidly, is easily transported and is quickly and easily repaired. Cocks were tapped into the mains, covered with a wooden box, but some difficulty has been experienced by trucks driving over the boxes, forcing cock out of the main, producing an irregular hole. Special brass plugs were cast in all corporation cock sizes, and when a cock was burst in the pipe the hole was reamed out in a true circle and the larger size plug inserted. A new tap was then made, a corporation cock inserted and a swing joint installed to relieve the rigidity of the service line. The wood pipe has proved itself unusually free from leakage. Only one serious break has occurred, which took place last winter on the main to the remount station, but from which no great inconvenience resulted. It was found that a sand scour had cut the wire, spreading the staves, the velocity of the water cutting a hole vertically in the pipe about 4 ins. in length and ½ in. wide. In making repairs on wood stave pipe, the defective section is removed, a special casting 21 ins. long with standard A. W. W. bell on one end and a bell of larger diameter on other end to receive wood stave pipe, is calked on wood pipe, a filler piece of cast-iron pipe is inserted where section of wood was removed, a sleeve placed of cast-iron pipe, and another special casting 21 ins. with large bell for wood stave on one end, and A. W. W. spigot on the other end, is placed at opposite end of break; joints are then calked and the line put in service.

Consumption. — The water consumption for the year beginning November 1, 1917, and ending October 31, 1918, has averaged 52 gals. per capita, which is slightly less than the original estimate before construction of 55 gals. per capita. It should be noted, however, that the estimate did not contemplate the use of steam for heating purposes. In attempting an estimate of water consumption for training camps, it is believed that it would be well to consider the per capita consumption for ordinary purposes, such as bathing, cooking, street sprinkling, etc., separately from that to be consumed in special uses, such as steam heating, refrigerating, etc. From various tests, it is estimated that the leakage is approximately 100,000 gals. per day, which will hardly be considered excessive. It has been the aim of the organization to prevent waste of water as much as possible, various devices being used, one of which produced notable results. A lead plug $\frac{1}{2}$ in. long, tapered $\frac{5}{8}$ in. to $\frac{3}{4}$ in. diameter and tapped with $\frac{1}{8}$ in. diameter hole, was inserted in the service pipe just back of each bibb or valve, and which reduced the consumption approximately 5 gals. per capita. Leaking of shower head valves was corrected by grinding into the core about $\frac{1}{4}$ in., tapping for a No. 17 brass screw and inserting a $\frac{1}{2}$-in. composition seat washer which resulted in a further saving of approximately 2 gals. per capita. Continuous inspection of all lavatories has been necessary, various instructions have been given relative to use of water, placards being used freely, and frequent replacement of washers.

Bathing by units at different hours was considered, but it is not considered necessary; the best results being obtained from corrections of defects and the coöperation of all in economical use of water. During the first four months of operations, the per capita consumption was high, but decreased rapidly as the population became accustomed to the economical use of water and again became high in July, 1918, when the new division was formed. It is noticeable, however, that the consumption was soon reduced to a fair rate. It will be noticed by the following figures that the daily average is considerably increased during the months when the heating plants are in operation.

Water Consumption.

	Ave. Consumption. Gals. per Day.	Ave. Population.	Ave. Gals. per Cap. per Day.
November, 1917	1 672 000	31 560	52.9
December	1 994 000	30 242	65.9
January, 1918	1 814 813	32 206	56.3
February	1 649 400	25 278	65.1
March	1 643 000	30 049	54.9
April	1 648 300	34 540	47.7
May	1 727 000	39 625	43.6
June	1 787 500	44 141	39.3
July	1 612 000	30 749	54.5
August	1 990 000	41 073	47.6
September	2 045 000	47 440	43.1
October	2 124 200	45 710	46.6
Total	21 707 213	432 613	623.8
Average	1 808 933	36 051	51.5
Maximum	(Oct.) 2 124 200	(Sept.) 47 440	(Dec., '17) 65.9
Minimum	(July) 1 612 000	(Feb.) 25 278	(June) 39.3

Plumbing.

In addition to the ordinary maintenance of plumbing fixtures, the repair work has been found to be enormous, owing greatly to the type of buildings which retain heat for only a short period. During January and February, 1918, over 12 000 ft. of galvanized pipe was used in repairing frozen pipes. Services were frequently frozen, but it is believed this difficulty has been overcome to a great extent by boxing-in service pipes, by filling with dry sawdust and covering the outside with tar paper, great care being used in making tight joints to the kitchen floors. In thawing service pipes, electricity was used to a great extent, description of the apparatus being given in the Light and Power Section. Last winter over 2 000 freeze-up jobs were recorded, but in no case was a building without water more than twenty-four hours, the trouble usually being remedied within six hours.

Considerable difficulty has been experienced with the hot-water tanks, which have not withstood the pressure; but it has been eliminated by the use of pressure-reducing valves.

About 2 500 repair jobs per month are completed by this department, requiring about thirty thousand hours' labor.

Sewers and Sewage Disposal.

Three separate systems are in use, two serving the Base Hospital, consisting of the collecting systems and two disposal plants, each being provided with a dosing tank and intermittent filters. The third or principal system collects from the camp proper, and the remount station, all carrying sanitary sewage only, the connections being with lavatories and kitchens.

The general drainage slopes to the valley of a brook running through and near the center of the camp, to a pump well located 6 200 ft. north of the northern boundary of the camp, from which point sewage is raised about 80 ft. to intermittent filters, about 3 000 ft. beyond. The main collecting system consists of district sewers, intercepting sewers and outfall sewers. The total length of all sewers, including Base Hospital and remount station, is about 22 miles; the house connections, which are all 6-in., amount to about 8 miles.

The plants at the Base Hospital are similar, excepting in number of beds — the first having six, covering about one and one-half acres in area, and the second four, covering about one acre. Each plant has a dosing tank 12 ft. by 24 ft., constructed of concrete with flat slab roof, and capacity of 13 000 gals. An iron bar screen is set in a small chamber at the entrance. The tank contains an 8-in. siphon 6-ft. draft, discharging into a concrete chamber, which is connected to the filters by a 10-in. pipe. An 8-in. pipe pass, controlled by a shear gate, connects the screening chamber with the discharge chamber, permitting work in the tank. The beds are under-drained with 4-in. pipe, the effluent being discharged into the Nashua River.

The Hospital plant was constructed to accommodate a population of 1 000 on a basis of 50 gals. per capita, but which has been greatly exceeded, normally averaging a population of 1 800 and producing an average dose of 81 000 gals. per acre. During the epidemic of Spanish influenza this fall, the population contributing to this plant was for a short time about 5 000; while this condition was abnormal, filtration was continued, and

although the beds were constantly flooded, the effluent samples remained stable for over two weeks. The following table gives analysis of raw sewage and effluent.

PARTS PER 1 000 000.

Source of Sample.	Week Ending.	Free Ammonia.	Album. Ammonia.	Chlorine.	Oxygen Consumed.	Residue on Evap. Total.	Residue on Evap. Fixed.	Nitrate.
Base H.	Sept. 9	11.6	12.9	39.6	308.0	960	290	2.6
No. 1.	16	15.5	14.5	68.0	316.0	1 050	274	4.4
Raw.	23	18.5	18.5	24.6	369.6	1 252	256	3.4
Sewage.	30	37.0	38.0	42.8	358.0	1 200	334	
Base H.	Oct. 7	18.0	20.0	47.8	348.0	960	214	4.00
No. 1.	14	14.0	18.0	60.0	362.0	1 030	316	3.50
Raw.	21	17.0	19.0	52.0	320.0	940	222	3.20
Sewage.	28	11.0	16.0	39.6	338.0	1 024	250	4.50

Septic tanks and sludge beds are now being constructed at this plant, which will relieve the situation.

The principal system requires pumping to the beds, a description of the pumping station being found under the Light and Power Section. The pump well, where the sewage is collected, is of concrete construction, with a slab roof supported on piers, circular in form, 61 ft., 6 ins. diam. and 150 000 gals. capacity. Sewage enters through iron bar screens, which slope to the roof of the well, in which are two openings, with perforated iron covers, on which screenings are raked and drained. A 16-in. pump suction passes through the well and terminates in a rectangular sump in the center.

An agitator is installed, but so far no deposit has been noticed on the floor of the well, making its use unnecessary.

The 20 intermittent filters, of one acre each, were built by removing top soil which was used in forming embankments separating into beds. No under-drains are necessary, the sand being particularly well adapted for this use. The flow to the beds is controlled by 12-in. shear gates, distribution being effected by wooden sluices having suitable spaced openings in the converging sides. Some difficulty is being experienced with grease.

Each kitchen is provided with a grease trap, 73 of which are of concrete and which have proved fairly satisfactory; the balance, 167, are of vitrified pipe and proved useless, retaining practically no grease, and are being replaced with a wooden trap, based on capacity of two thirds per gallon per capita.

Executive and Engineering.

As soon as possible, in forming the organization, a system was installed, which has worked satisfactorily and which has permitted the compiling of statistics.

Each section has its distinct location in the general office, has 'phone service through a private switchboard, which also extends to each central heating plant, each pumping station, storehouse office, shops and personnel office. The fire stations are in the camp exchange. One desk receives all complaints, night and day service being maintained. From this desk the complaint goes to the section interested, except at night, when in event of an emergency the trouble is reported to a man on watch in the personnel office, who delivers the message to the proper foreman. Job tickets are made in triplicate, two to the foreman, who uses one in securing material from the storehouse; one is retained until the job is completed, when turned back to the office with the hours of labor and material used, which is then figured for cost and charged against the proper building or system. These costs are all compiled monthly. Each section chief requiring material makes requisition on the Purchase and Contract Section, where the material is purchased, and which when delivered is received and checked by the Property and Supply Section, after which invoices return to the Purchase and Contract Section to be vouchered and paid.

In each section complete logs are kept of the operation of stations and plants, and monthly reports are made by each section to the officer in charge, containing in detail the activities of operating and maintenance.

No attempt has been made in this paper to give details of the management or various forms used, as this to some extent depends upon the individual camp to be operated. Such records

are kept as will show amount of labor and material against each building or system.

The necessity for a small engineer division was early recognized, and a force of seven engineers and three draftsmen was formed, the section being in charge of a sergeant first class, all the others having grade of sergeant. Two parties are kept in the field continuously; in fact, it has at times been necessary to increase this force. All plans are kept up to date, showing changes and additions.

Purchases and Contracts.

This section at present requires only a few experienced non-commissioned officers and clerks, whose work is supervised by the executive officer. In time, however, it can be readily seen that an officer might be required to give his entire attention to this section.

Property and Supplies.

All material and tools, after being paid for, become property of the Government, and a strict accounting must be kept. Ordinary building supplies used in maintenance work can be expended and dropped from the records when used, but all tools of every nature must be retained on the records, and can only be dropped when unserviceable by survey or other methods. The fact that a shovel is broken or worn out does not affect the case at all, it must be carried until property is dropped. The work requires the supervision of an experienced commissioned officer with a small but efficient force.

Personnel.

In operating the utilities of a camp with soldier labor, many advantages are obtained, particularly in the case of control of the organization; on the other hand, many responsibilities must be assumed which would not be necessary in civilian practice, where the responsibility ends with supervision over the working hours of the force. In the military service, everything

a soldier eats, wears or uses in his work must be provided for him. Constant medical attention must be furnished; frequent inspections must be held, that the health and morale of the command be maintained at as high a degree of efficiency as possible. To do all this requires a considerable clerical and supervising force, as the method is all prescribed by regulations. A certain allowance of food is made per day, which to a great extent is drawn from the subsistence stores; clothing must be requisitioned and issued, and tools of all description secured; for all of which a strict account must be made.

Various records are kept of each enlisted man, and monthly reports must be made. The paper work of an organization is really enormous, and requires experienced men for this purpose. Soldier cooks must be provided, barracks must be kept orderly and grounds must be kept neat. Of the force of 850 men at this camp, about seventy are required on this work, including the clerical force of the personnel officer who at present assumes this duty in addition to his position of assistant engineer, Heating Department. The work, however, is important enough to require all the time of a capable officer.

An unusually capable organization has been made possible owing to skilled mechanics who were selected in the draft, but considerable doubt is held as to the possibility of securing this same class of mechanics for service during peace times.

Should the camp be maintained for a considerable time, and the enlisted men discharged, a very grave problem would arise in securing an efficient force. The pay of a sergeant is forty-four dollars per month, and although his every want is provided, yet the average mechanic could hardly be expected to view with favor the idea of enlisting for such remuneration. This situation, however, will not have to be faced for several months.

Fire Protection.

A unit designated as the 301st Fire Truck and Hose Company is under the direction of the utilities officer, and consists of a first lieutenant, officer in charge, and the following enlisted personnel:

1 Supply sergeant,	Quartermaster sergeant.
3 Station chiefs,	Sergeants first class.
3 Assistant station chiefs,	Sergeants.
12 Firemen,	Privates first class.
24 Fire Department Reserves,	Privates.

One station is located at the Base Hospital, two in the camp proper, and one at the remount station.

The apparatus consists of one American La France pumping engine, capacity 750 gals. per minute, with a 40-gal. chemical tank; two combination hose and chemical wagons, each equipped with one 40-gal. chemical tank; and three Howe-Ford combination engines.

Ordinary city practice in managing the Fire Department is followed, except that the service of the men is almost continuous, no man being permitted to be absent oftener than twenty-four hours in ten days. Inspections are carried on by designated men from each station in the area where located, to see that the buildings have the necessary number of water pails, hand pumps, chemical extinguishers, etc., and that rubbish, waste paper, etc., does not become a fire hazard. Companies are drilled each day with the apparatus and its appliances. During the winter months, to prevent freezing, calcium chloride is mixed with the water in the barrels, hand pumps and pails that are located at the storehouses, stables, etc., which are not heated. In each regimental area, an assistant fire marshal is appointed who co-operates with the officer in charge of the Fire Truck and Hose Company, and the officer in charge of utilities.

Forty hose-reel houses, each containing a reel and 500 ft. of 2½-in. hose are distributed throughout the camp, and have not proved of any particular value.

The fire-alarm system as originally laid out consists of 36 fire boxes located at advantageous points throughout the cantonment. Each box contains a common telephone and is connected with a special signal in the central exchange of the telephone company, which serves the cantonment only. The signaling apparatus, which transmits the box numbers to the house gongs and recording tapes in the stations, was also located in the telephone office, and the chief operator transmitted all

alarms of fire from the telephone boxes to the gong circuit. In addition to this signaling apparatus, there was installed a system of automatic alarms in the various quartermaster and ordnance storehouses in the camp, which transmits automatically an alarm to the various house gongs which corresponds to the storehouse in which a fire may arise. There are, at the present time, 15 storehouses protected by this automatic service.

In addition, there is being installed at the Base Hospital, at the present time, an automatic system of 54 separate stations which will afford complete protection for this very important area.

Since the original installation, it has been deemed advisable to move all apparatus connected with the camp fire-alarm system to fire headquarters, and at the present time this work is being carried out with a view of eliminating all of this apparatus from the telephone exchange building and moving the same to fire headquarters, where it rightfully belongs. When this change has been made, all alarms will be received directly at fire headquarters, where the proper transmittal to the various fire stations will take place.

In order to warn all units in the cantonment of an alarm of fire, there is installed at fire headquarters building a compressed air siren. This siren serves not only to indicate alarms of fire, but is also used for certain special calls at the convenience of the commanding general.

The fire loss has been extremely low in camp, the result being obtained by rigid inspections and strict attention being given at all times to fire prevention.

In looking back during the past year it is possible to see where many operating features have been improved and also where some conditions can be improved in the future. These, however, are of rather a minor nature. The total number of repair jobs completed during the year exceeds 65 000, all of which were made necessary by ordinary use of buildings and systems.

The work has been arduous, but at all times interesting, many problems continually arising which are not met in civil life.

Considerable of the satisfaction in operating is due to the careful engineering work during construction, which was under the direction of Mr. Frank A. Barbour, supervising engineer, whose paper presented to the Boston Society of Civil Engineers, on "Camp Devens and Its Water Supply," contains considerable data and explanation not included in this paper.

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PAPERS AND DISCUSSIONS

DISCUSSION OF THE OPEN-AIR TREATMENT OF INFLUENZA.

By Charles F. Dingman,* Member Boston Society of Civil Engineers.

It was indeed refreshing to read Colonel Brooks's description of the open-air treatment given influenza patients at Camp Brooks and elsewhere in the state. It may well be that this marks the commencement of an era when common-sense methods will be applied to the cure of all such diseases.

However, none of the three articles seems to me to offer any solution of the problem of preventing a recurrence of such an epidemic, nor in fact do any of them approach the subject in a manner which, to my mind, is calculated to shed any light upon the real cause of the epidemic.

Major Harrington's paper raises the significant point that "most of the cases received at our hospital were boys between eighteen and twenty-four years, supposed to have been physically fit. They had been struck down like little children."

Some time ago I wrote a letter to the editor of the Springfield *Republican* on this very point. While the arguments advanced by me in that letter may not have been original, the fact that the letter has been extensively quoted since seems to show that it struck a sympathetic note in the minds of many others who were also thinking of the appalling mortality among our younger people from this disease. I am taking the liberty of repeating part of that letter here:

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". . . It seems to me that even though the descriptions of the various kinds of bacteria that are present in the different manifestations of the disease are of great importance and interest from an academic standpoint, the real solution to the problem of preventing the spread of the present epidemic and the outbreak of future epidemics has not even been approached.

"The present epidemic is said by some writers to be traceable to its source in the German trenches. This is very probably true, but, on the other hand, there were a great number of cases of 'summer pneumonia' or 'camp pneumonia' reported at the various camps and cantonments in this country last summer, and I do not believe that any connection could be traced between these cases and the German trenches.

"There was, however, a condition present in the camps and cantonments in this country that was also present in the German trenches and which I believe will ultimately be found to have provided the means of propagating the disease, by whatever name it is known. I refer to the great numbers of men who have recently been inoculated with animal virus or sera in the hope of rendering them immune to the attacks of smallpox and typhoid fever.

"The established schools of medical thought will not agree with this statement, and therefore it will be difficult to produce officially published statistics to back it up at this time, but it is my firm belief that any open-minded investigator who had access to the records could soon establish the fact that, whenever a person has been inoculated with animal poison in any form, be it vaccine or anti-toxin, and the first effects have worn off, he may show an apparently increased resistance (though the reverse is often the case) to the infection corresponding to the inoculant used, but a very decreased resistance to other infections, and particularly those of pulmonary diseases.

". . . One of the reasons why this much more virulent outbreak may be traced so directly back to the German trenches probably lies in the fact that the Germans are a much more thoroughly vaccinated and re-vaccinated people than we Americans are. In Germany they start vaccinating the children before they are a year old and repeat it so regularly that by the time one of them reaches the age at which he is taken into the army, his system has become so thoroughly saturated with the products of the vaccine that he becomes a ready victim to the attack of 'grippe,' 'pneumonia,' 'influenza,' or whatever other form the disease happens to take at that particular time and place."

I believe that in those two paragraphs will be found the answer to Major Harrington's question if some one of an open mind, and who has the necessary facilities, will but take the time and put forth the necessary effort to make a thorough investigation. None will question the fact that the epidemic found its first great concentration points at the places where men of the army, navy or merchant marine were stationed. These were all men who were selected because of their physical fitness, and who could ordinarily be most depended upon to resist attacks of disease.

But — each and every one of them had recently been vaccinated, and who is there who can definitely tell us just what the effect of vaccine is upon the human system? Of course, the great number of cases of influenza at the stations mentioned made it but a matter of time until it should find its way out among the civilian population.

MEMOIR OF DECEASED MEMBER.

FRANK ALBERT PEIRCE.*

Frank Albert Peirce was born in Taunton, Mass., May 23, 1869, the son of Oliver Albert and Sarah (Pickens) Peirce. He was elected a member of this Society September 16, 1896.

He attended the public schools of Taunton and graduated from its high school in 1886. He was in the employ of George A. King in civil engineering in Taunton during the latter part of his school life and continued with him until April, 1890, except during three months in 1886, when in the employ of the United States Geological Survey in Massachusetts.

He left Taunton in the spring of 1890 for the South and arrived in Chattanooga, Tenn., while the "boom town" fever was raging in that section and obtained employment with Nier, Hartford & Mitchell. He was in charge of surveys at Kimball, Tenn., Goshen, W. Va., and Asheville, N. C.

He established business for himself in Greensboro, N. C., in 1891, and was appointed United States surveyor in the Circuit Court, Western District of North Carolina, in 1893 and 1894. He became interested in timber land in this section and purchased several thousand acres in the mountains of southwestern North Carolina. He had charge of the construction of two large mills in Greensboro.

He was engineer for Moses and Caesar Cone, and while in their employ on a case where the question of malaria was involved, studied into the part mosquitoes play in causing that disease, a question then being actively discussed.

While carrying on business for himself he was employed at different times in the South, by C. R. Makepeace & Co., mill architects, of Providence, R. I., and they engaged him to act as

* Memoir prepared by George A. King and Luther Dean.

inspector on work of about $900 000 in value at Lawrence, Mass. In 1901 he was appointed manager of this company's southern office, with headquarters at Spartanburg, S. C., and remained in this position about four years. During that period they constructed the Brogon Mills at Anderson, S. C., and Clifton, S. C., and additions to the Eno Cotton Mills at Hillsboro, N. C., and to the Swift Spinning Company, Columbus, Ga.

About 1904, he entered the employ of T. C. Thompson & Bro., and later became a member of the firm. While with this firm they built the Hamberger Mills.

He then took up construction work as contractor, with headquarters at Columbus, Ga. Among the buildings erected by him were large mills for the Muscogee Company, the Columbus Manufacturing Company, the Swift Manufacturing Company and the Eva Jane Mill at Sylacauga, Ala.; a tank and dye house for Perkins Hosiery Mill; and a coagulating basin, filter house, and clear water reservoir of 2 500 000 gals. capacity for the Columbus City Water Works. He also built the Gordon House, one of the finest residences in Columbus, and was building an addition to the Eno Mills at Hillsboro, N. C., at the time of his death.

He died at the Watts' Hospital, Durham, N. C., August 7, 1917. Mr. Peirce never married. He was strongly attached to his mother, who survives him. He was a Republican in politics, and inherited from his Pilgrim and Scotch-Irish ancestors a strong, outspoken mind, but his sound, good sense prevented his antagonizing the prejudices of people with whom he associated.

The people of Columbus regarded him as "a good business man, and gave him their trust and confidence unreservedly"; and mill men looked upon him as one upon whom they could depend for aid in the future advancement of the South. One of those who had employed him says, "We considered Mr. Peirce an extraordinary man in his line. . . . I am sure, in every instance owners were entirely satisfied with what he gave them."

Vol. VI MARCH, 1919 No. 3

BOSTON SOCIETY OF CIVIL ENGINEERS

FOUNDED 1848

PROCEEDINGS

PAPERS IN THIS NUMBER.

"The Boston Army Supply Base."

"General Features of Project." Frederic H. Fay.
"Construction Features." Charles R. Gow.
"From the Contractor's Standpoint." Wm. H. Kearns.
"General Data." Charles M. Spofford.

Current Discussion.

Paper.	Author.	Published.	Discussion Closes.
"The Operation of the Utilities at Camp Devens, Mass."	E. W. Briggs.	Feb.	Apr. 10.

Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

MINUTES OF THE MEETING.

Boston, February 19, 1919. — A regular meeting of the Boston Society of Civil Engineers was held this evening in Chipman Hall, Tremont Temple, and was called to order at 7.50 o'clock by the President, Charles M. Spofford.

There were present 205 members and visitors, including ladies.

The record of the January meeting was read and approved.

The President reported for the Board of Government the election to membership in the grade of Member of Messrs. Raymond H. A. Carter, James Andreas Christenson, Linton Hart and Thomas Bartholomew Kenney.

The President also reported for the Board of Government that it had considered the matter referred to it by the Society at the last meeting, in relation to the recognition in special manner of the members who were responsible for the resuscitation of the Society in 1874, and that the Board recommended the passage of the following:

Voted: That those members who took part in reviving the Society in 1874 be exempted from further payment of dues, and that their names be listed separately in the membership list.

By a unanimous vote the recommendation was adopted. The names of the members to whom this vote will apply are Desmond FitzGerald, Frank L. Fuller, Clemens Herschel, Edward W. Howe, Wilbur F. Learned, Henry Manley, George S. Rice and Francis C. Tucker.

The President announced the deaths of the following members of the Society, and by vote the President was requested to appoint committeees to prepare memoirs:

James Hayes, Jr., who died September 26, 1918.
Fred E. Sauer, Jr., who died January 20, 1919.
Gilbert Hodges, who died February 13, 1919.
John S. Humphrey, who died February 15, 1919.

Mr. Desmond FitzGerald, for the committees appointed to prepare memoirs of Past President Frederick Brooks and Mr. Thomas Aspinwall, read the memoirs which had been prepared, and they were accepted and ordered printed in the JOURNAL.

Mr. Isaac W. Litchfield, chief of the Professional Section, U. S. Employment Service, Department of Labor, was then introduced and spoke of the work already done by the New England Employment Service and what it hopes to do in the future.

The President then called on Past President George F. Swain, who spoke of "The Engineering Conditions and Problems in France." Professor Swain was one of the delegation of American engineers sent to France in response to an invitation from the French Congress of Civil Engineers, to confer with members of that Congress on matters of reconstruction, particularly along civil engineering lines. Professor Swain, with the aid of lantern slides, gave a most interesting and graphic account of the conditions which he found in France, and spoke of the work done by the delegation of American engineers and what he hoped would be accomplished by the appointment of a permanent Franco-American International Engineering Committee.

A short discussion followed, in which President Spofford, Mr. FitzGerald, Mr. Stearns and others took part.

Adjourned.

S. E. TINKHAM, *Secretary.*

APPLICATIONS FOR MEMBERSHIP.

[March 15, 1919.]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

FALKENBERG, JOHN JOSEPH, Boston, Mass. (Age 20, b. Caldwell, Kans.) Received degree of B.S. at Mass. Inst. of Technology with Class of 1919, civil engineering course. Refers to J. B. Babcock, 3d, C. B. Breed, Dwight Porter, A. G. Robbins, G. E. Russell and C. M. Spofford.

GAGE, ELLIOT HOWES, South Weymouth, Mass. (Age 27, b. Brooklyn, N. Y.) Graduate of Mass. Inst. of Technology, 1913, sanitary engineering course. From June, 1913, to May, 1915, assistant in Engrg. Div., Mass. State Dept. of Health; from May, 1915, to April, 1916, member American Red Cross Sanitary Comm. to Serbia; from June to December, 1916, assistant engineer on water works and sewer construction at Lyons, N. Y.; from January to May, 1917, draftsman with Burgess Co., Airplanes, Marblehead, Mass.; from May, 1917, to January, 1919, in military service, covering three months in training camp, 14 months as 2d Lieut., Engrs., U.S.R., and three months as 1st Lieut., Engrs., U.S.A.; from February, 1919, to date, assistant in Engrg. Div., Mass. State Dept. of Health. Refers to Bertram Brewer, X. H. Goodnough, H. E. Holmes, Dwight Porter and C. M. Spofford.

JACKSON, RALPH TEMPLE, Boston, Mass. (Age 39, b. Great Pond, Me.) Graduate of Mass. Inst. of Technology, 1906, degree of B.S. in Architecture; received degree of M.S., 1907. From 1907 to 1909, superintended construction of New Union Hospital, Fall River, Mass. — steel and concrete construction; maintained office in Fall River from 1909 to 1915, and in Boston from 1915 to 1917, carrying out as architect and engineer approximately $2,000,000 worth of work, mainly reinforced concrete construction; from 1917 to July, 1918, employed as engineer by American Shipbuilding and Transportation Co. to lay out yard and mill, and by New England Ship and Barge Co. to design concrete on coal barge and cargo vessel; from July, 1918, to date, with Fay, Spofford & Thorndike on Boston Army Supply Base. Refers to B. A. Bowman, F. H. Fay, H. A. Gray, H. F. Sawtelle, C. M. Spofford and David Sutton.

REED, CARL BICKNELL, Norwood, Mass. (Age 26, b. South Weymouth, Mass.) Graduate of Worcester Polytechnic Inst., 1917, Sanitary Civil Dept. Until April, 1918, assistant state chemist, Concord, N. H.; from April, 1918, to date, with exception of two months in Sanitary Corps, U.S.A., chemist with Metcalf & Eddy. Refers to H. P. Eddy, A. L. Fales, A. W. French, A. L. Maddox and Leonard Metcalf.

WHITNEY, GORHAM HORATIO, West Medford, Mass. (Age 38, b. Roxbury, Mass.) Has been connected with Bay State Dredging & Contracting Co. for past twenty years, doing river and harbor improvement work; is now president and general superintendent of that company. Refers to H. S. Adams, C. R Gow, F. W. Hodgdon, H. C. Robbins and J. W. Rollins.

ROLL OF HONOR.*

ADDITIONS.

Coffin, Grover C. Private, Battery A, 119th Field Artillery, Am. Ex. Force, France.

†Coombs, Anthony A. Field Artillery Central Officers' School, Camp Taylor, Ky.

†Tannatt, Willard C., Jr. Captain, Engineers, U.S.A.

Whiting, Mason T. Captain, U. S. Service Club of America, DuPont Circle, Washington, D.C.

REVISIONS.

Craigue, Joseph S. Captain, Engineers, U.S.A., Chief Gas Officer, 2d Div., A. P. O. 710, Am. Ex. Force.

Rand, Robert. Lieutenant, U. S. N. R. F., Asst. Force Communication Officer, U. S. Naval Headquarters, 30 Grosvenor Gardens, London, England.

Sawyer, George S. 2d Lieutenant, Engrs., U. S. A., Adjutant Section Engr. Office, Base Section No. 6, A. P. O. 752, Am. Ex. Force, France.

Strout, Henry E., Jr. Captain, Corps of Engrs., U. S. A., 319th Engrs., Am. Ex. Force.

Wiggin, Thomas H. Major, Engrs., U. S. A., Am. Ex. Force, France.

Worcester, Robert J. H. 1st Lieutenant, Co. E, 117th Engrs., Am. Ex. Force.

LIST OF MEMBERS.

ADDITIONS.

Calderara, Charles A.	20 Prospect St., Rockland, Mass.
Carter, Raymond H. A.	34 India St., Boston, Mass.
Christenson, James A.	Southbridge, Mass.
Hart, Linton	80 Boylston St., Boston, Mass.

CHANGES OF ADDRESS.

Barney, Harold B.	P. O. Box 292, Fall River, Mass.
Bresth, Alexander,	Mass. State Dept. of Health, State House, Boston, Mass.
Brown, H. Whittemore	Elm St., Concord, Mass.
Buckley, William J.	21 Colby Rd., Atlantic, Mass.
Carter, Gale A.	Colebrook, N. H.
Carter, Harold L.	369 Tappan St., Brookline, Mass.

* Members who are in the service and have not yet reported that fact to the Secretary are earnestly requested to do so, stating branch of service, rank and military address.

† Has now been discharged from the service.

Coghlan, John H. . . . . High Bridge, N. J.
Colby, Edwin W. . . . . 4815 Washington St., W. Roxbury, Mass.
Eddy, Harrison P., Jr. . . . . 14 Beacon St., Boston, Mass.
Flaws, James B. . . . . 21 Elm St., No. Woburn, Mass.
French, Charles A. . . . . Masonic Temple, Laconia, N. H.
Fuller, Andrew D. . . . . 3 Hamilton Pl., Boston, Mass.
Gartland, Edward V. . . . . Commonwealth Pier 5,
Care Waterways and Public Lands Comm., Boston, Mass.
Guppy, Benjamin W. . . . . B. & M. R. R., North Station, Boston, Mass.
Hartwell, David A.,
Commissioner of Public Works and City Engr., Fitchburg, Mass.
Harwood, T. T. Hunter . . . . 90 Main St., Rockport, Mass.
Horton, Freeman H. . . Care Coast and Geodetic Survey, Washington, D.C.
Johnson, Frank W.,
Care Raymond Concrete Pile Co., 140 Cedar St., New York, N. Y.
King, Arthur C. . . . . 228 Haddon Ave., Westmont, N. J.
Porter, Arthur P. . . . . Care New England Power Co., Worcester, Mass.
Putnam, Charles E. . . . . 33 Beacon St., Boston, Mass.
Restall, Charles H.,
Care F. F. Jonsberg Co., Old South Bldg., Boston, Mass.
Richardson, Edward B. . . . . 7 Chatham St., Brookline, Mass.
Robinson, Ashley Q. . . . . 53 4th St., Attleboro, Mass.
Sanborn, Frank B. . . . . 79 Sudbury St., Boston, Mass.
Sears, Calvin C. . . . . 3 Bryan Rd., Branford, Conn.
Skillin, Fred B. . . . . 43 Van Reipen Ave., Jersey City, N. J.
Stone, George C. . . . . Altavista, Va.
Wadsworth, George R.,
Care United Aircraft Engrg. Corp'n, 52 Vanderbilt Ave., New York, N. Y.
Wilson, Albert O. . . . . 135 Winsor Ave., Watertown, Mass.
Young, Erving M. . . . . 11 Warren St., Haverhill, Mass.

DEATHS.

Hodges, Gilbert . . . . February 13, 1919
Humphrey, John S. . . . . February 6, 1919
Sauer, Fred E. . . . . January 20, 1919

EMPLOYMENT BUREAU.

The Board of Government has established an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society rooms two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

Men Available.

445. Age 47. Graduate of Dartmouth College, degree of B.S. Experience covers five years with Massachusetts Metropolitan Water Board on reservoir construction and seventeen years in responsible charge of important municipal work; recently discharged from U. S. Army, where he held rank of captain, Q. M. C., Construction Division, having been assigned as officer in charge of utilities at U. S. A. general hospital. Would be interested in engineering position dealing with water, sewers, streets or operation and maintenance of utilities. Salary desired, $3 000 per year.

446. Age 20. High-school graduate and student for four months at U. S. Naval Academy, Annapolis, Md. Has had experience as rodman with party laying out townships in Arizona desert, and as "sampler" on diamond drills for copper company. Desires position as rodman or chainman.

447. Age 36. Graduate of Brown University, 1903, civil engineering course, degree of S.B. Experience includes eight years as draftsman and instrumentman on preliminary investigations and design for sewer systems and sewage disposal, land drainage and road construction; has also had experience as draftsman in maintenance of way department of railroad and as mechanical draftsman with steam gage and valve company. Desires position as draftsman and surveyor. Salary desired, $85 per month.

449. Age 21. Graduate of Mass. Inst. of Technology, civil engineering course, degree of B.S., having taken both hydraulic and railroad engineering options. Experience consists of one summer at surveying camp of Mass. Inst. of Technology and surveys in connection with Coast Artillery Officers' Training Camp, Fort Monroe, Va.

LIBRARY NOTES.

Recent Additions to the Library.

U. S. Government Reports.

Annual Report of Director of Bureau of Mines for 1917–18.

Annual Report of Director of Geological Survey for 1917–18.

Book Lists compiled for United States Shipping Board on following subjects: Foreign Countries; Foreign Languages; Ships, Commerce and Merchant Marine; World Trade. (Miss) M. L. Prevost, comp.

Central Station Heating. John C. White.

Colloids and Flotation. Frederick G. Moses.

Contribution to Geology of Northeastern Texas and Southern Oklahoma. Lloyd William Stephenson.

Fuel Administration Engineering Bulletins as follows: Boiler and Furnace Testing; Saving Coal in Steam Power Plants; Boiler Water Treatment; Combustion and Flue Gas Analysis; Burning Steam Sizes of Anthracite; Saving Steam in Industrial Heating Systems.

Gold, Silver, Copper, Lead and Zinc in Eastern States in 1917. James M. Hill.

Graphite in 1917. Henry G. Ferguson.

How to Improve the Hot-Air Furnace. Charles Whiting Baker.

Innovations in Metallurgy of Lead. Dorsey A. Lyon and Oliver C. Ralston.

Magnesium in 1917. Ralph W. Stone.

Melting Brass in Rocking Electric Furnace. H. W. Gillett and A. E. Rhoads.

Methods of Shutting off Water in Oil and Gas Wells. F. B. Tough.

Peat in 1917. C. C. Osbon.

Petroleum in 1916. John D. Northrop.

Description of Quantitative Classification of Igneous Rocks with Tables for Calculation of Norm. Henry Stephens Washington.

Recreation Uses on National Forests. Frank A. Waugh.

Rock Quarrying for Cement Manufacture. Oliver Bowles.

Shorter Contributions to General Geology, 1917. David White.

Talc and Soapstone in 1917. J. S. Diller.

Use of Hydrogen-Volatile-Matter Ratio in Obtaining Net Heating Value of American Coals. A. C. Fieldner and W. A. Selvig.

Water Systems for Farm Homes. George M. Warren.

Water-Supply Papers 410, 413.

When Coal-Oil Johnny Goes to Sea. Edward N. Hurley.

Why Our Ships Will Now Stay on the Ocean. Edward N. Hurley.

State Reports.

New Hampshire. Report of Commission on Water Conservation and Water Power, 1917–18. Gift of C. H. Pierce.

Municipal Reports.

Hartford, Conn. Annual Report of Water Commissioners for 1917–18.

Providence R. I. Annual Report of Department of Public Works for 1918.

Miscellaneous.

American Highway Engineers' Handbook. Arthur H. Blanchard.

American Society of Mechanical Engineers: Transactions for 1917.

Railway Statistics of United States of America for 1917. Slason Thompson, ed.

Wharves and Piers. Carleton Greene.

LIBRARY COMMITTEE.

Vol. VI MARCH, 1919 No. 3

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications

THE BOSTON ARMY SUPPLY BASE. — GENERAL FEATURES OF PROJECT.

By Frederic H. Fay,* Member Boston Society of Civil Engineers.

(Presented December 18, 1918.)

Our entry into the war brought to this country vast problems of production and transportation and the necessity for the coördination of our national resources, tasks which greatly overtaxed our then existing war machinery. For the solution of these problems the aid of the ablest civilians was sought and secured, to supplement the personnel of the government departments and bureaus. The country awoke to the fact that war had become a business and not merely a profession.

The Council of National Defense, a civilian organization, was set up in the spring of 1917, for the general study and planning of our war activities. Through committees of business and professional men who were specialists in their respective lines, the Council undertook to survey conditions in diverse fields of activity, all needed for the winning of the war, and to make recommendations for the coördination of these activities into a complex but complete and smoothly running war machine.

* Of Fay, Spofford & Thorndike, Consulting Engineers, 308 Boylston Street, Boston, Mass.

Note. — Discussion on this paper is invited, to be received by W. L. Butcher, Editor, 715 Tremont Temple, Boston, Mass., before May 10, 1919, for publication in a subsequent issue of the Journal.

Among the many committees of the Council of National Defense was the committee on Terminal Port Facilities, under the able chairmanship of Francis Lee Stuart, a consulting engineer of New York, who had formerly been chief engineer of the Erie and later of the Baltimore and Ohio railroads. This committee was charged with the duty of studying the ports of the country, of making recommendations as to what ports should be selected for war work, and of making suggestions as to how the selected ports might best be utilized and developed to handle the vast amount of overseas shipments necessary for the transportation to and maintenance of our army in France. The work of the Committee on Terminal Port Facilities was essentially an engineering study of existing facilities at our principal ports, and the outlining, in a general way, of such additional facilities as might be found necessary; and the committee, as at first organized, included engineers prominent in port work of some of the larger ports of the country, other than Boston.

In July, 1917, consideration having been given to New York and certain other Atlantic ports, the attention of the committee was directed toward Boston, and as the speaker chanced to be in Washington at the time he was asked to attend a meeting of the committee and give some information as to conditions at this port. At this meeting of the committee a wire was sent to the Commission on Waterways and Public Lands of Massachusetts, requesting that a certain engineering representative of that Commission, who was most familiar with conditions at this port, be designated as a member of the Committee on Terminal Port Facilities — an assignment which, had it been granted, would not only have been most fortunate for the port of Boston, but equally helpful to the committee in its war work.

In the summer of 1917 there was a general feeling in Washington that it was useless to develop Boston as a war port owing to the hopelessness of the railroad situation in New England. Erroneously, the impression had gone abroad that our New England railroads were in such poor shape that they could not properly handle the business then passing through this port, and that further port business here was out of the question. It was most unfortunate for Boston and New England that this

false impression of our railroad situation was generally held throughout the rest of the country, and this doubtless accounted for some delay on the part of the Committee on Terminal Port Facilities in giving consideration to the port of Boston.

The summer of 1917 passed without any outward indication that, so far as this country's war activities were concerned, the port of Boston was even on the map. To many it seemed that the fate of the port were hanging in the balance; that if vastly improved facilities for our war commerce should be provided at other ports, and nothing were done at Boston, traffic routes through other ports would become so firmly established during the war that when peace came Boston would find that her prestige as a port had gone forever. The seriousness of the situation and the fact that if anything were to be accomplished Boston must be aroused to the necessity of doing something for herself were impressed upon the directors of the Boston Chamber of Commerce at a meeting in late September, by Mr. H. P. Kendall, a director of the Chamber who had spent some months in Washington as a member of the Storage Committee of the Council of National Defense. Our Chamber of Commerce was quick to appreciate that unless something were done to convince Washington authorities that Boston was a suitable war port, no steps were likely to be taken toward providing a Government port development here, and that Boston's future standing as a port was in jeopardy. Through a special committee, the Chamber began at once the preparation of a report to be submitted to Washington setting forth the actual conditions at this port and the possibilities of utilizing Boston for the storage and shipment overseas of war supplies. While the report was in preparation, Mr. Stuart, chairman of the Committee on Terminal Port Facilities, came to Boston by invitation of a member of the Chamber, inspected our waterfront, and met at luncheon the presidents of the Boston and Maine and Boston and Albany Railroads and the vice-president in charge of the operation of the New Haven Road. These railroad representatives convinced Mr. Stuart, himself a railroad man, that the New England railroad situation was by no means in the decrepit and chaotic condition that had been pictured at Washington; that not only

were these three railroads fully capable of handling the then existing Boston business but that they could take care of a substantial increase as well; and that arrangements would be made between the three roads for the transfer of carload freight from one road to another so that freight from all the roads could be brought to any point on the waterfront which might be selected as a government storage and shipping terminal. These railroad representatives made it plain that their roads desired to coöperate in every way toward the upbuilding of Boston and aiding the Government to win the war.

As the result of his inspection of Boston's waterfront, Mr. Stuart agreed with the Chamber of Commerce Committee that the Commonwealth lands at South Boston were the logical site for a government war terminal. On October 18, 1917, a few days after Mr. Stuart's visit to Boston, the Chamber's report upon the suitability of the port of Boston for the storage and shipment of war supplies was presented and explained at a meeting of the Committee on Terminal Port Facilities at Washington. The report suggested that Commonwealth Pier No. 5, in South Boston, as fine a pier as any in this country, and at that time practically idle, could be utilized immediately not only for overseas shipments but for some storage as well, and that temporary storage warehouses could soon be built upon the vacant Commonwealth lands south of Summer Street, between C and E streets, all of which were readily accessible by rail. After a consideration of this report and the report of the chairman upon what he had found as to conditions at Boston, the Committee on Terminal Port Facilities at this meeting voted unanimously to recommend the selection of Boston as an embarkation port, to recommend the lease by the Federal Government of Commonwealth Pier No. 5 and the utilization of such Commonwealth lands at South Boston as might be found necessary.

On October 20, 1917, a delegation headed by President Harriman of the Chamber, representing the Chamber of Commerce and other commercial interests of New England, the Public Safety Committee of Massachusetts, and including the mayor of Boston and other city and state officials, had a conference at Washington with the Secretary of War, at which the

facts as to Boston were set forth and Boston's value to the country as a war port was urged, but the Secretary was non-committal as to what use, if any, would be made by the Government of the port of Boston. Here the matter apparently ended, for the time being, and we heard nothing further regarding the Government utilization of this port until January of this year.

On January 28, 1918, the speaker was called to Washington for a conference with Major-General Goethals, acting quartermaster-general, and director of storage and traffic, Major (now Colonel) Wells, director of storage, and Major (now Colonel) Gunby, in charge of the engineering branch of the Construction Division of the Army. The Chamber of Commerce report lay upon General Goethal's desk. At this conference the general outlined in brief his ideas as to a Government war terminal at Boston. He was convinced as to the Government's need of this port. He did not believe that the lease or purchase of Commonwealth Pier and the provision of temporary warehouses on the land south of Summer Street, as suggested in the Chamber's report, was the best proposition or one adequate for the Government's requirements. Larger and better facilities were needed, and whatever was provided should be of permanent character, useful not only for the present war but also for future wars should they, unfortunately, ever come. Furthermore, a permanent terminal should be provided which would not only be useful for storing and shipping war supplies but would be equally adapted to commercial uses after the war, should the Government wish to lease or dispose of its property. As the result of his examination of the plans of Boston Harbor, General Goethals suggested that a Government pier be built on the Commonwealth flats just east of the Fish Pier bordering the main ship channel, and that on the land immediately back of the pier the Government should build storehouses of permanent construction providing about two million square feet gross floor area. The speaker was asked to make an investigation and report upon this suggestion.

To General Goethals, then, is due the credit for the inception of the plan which has finally resulted in the Boston Army Supply Base development.

Right here we may explain the relation of General Goethals and the Construction Division of the Army to this project. As director of storage and traffic it was General Goethal's province to determine in a general way the Army's requirements as to storage and shipping facilities; and later, after the facilities were built, to operate the terminal through his subordinate officer, the director of storage.

The responsibility for the design and construction of army plants such as this rests with the Construction Division of the Army, an independent division of the War Department reporting directly through the chief of staff to the Secretary of War. The Construction Division is the outgrowth of the Cantonment Division which was organized in the spring of 1917 to build the great army camps or cantonments throughout the country. The building of these camps was such a notable success that upon the completion of this huge undertaking, in the fall of 1917, the construction work for the Army in this country was turned over to this division which thereafter was known as the Construction Division. It is the Construction Division's function to take the general requirements of the other divisions of the War Department, prepare the necessary designs and carry out the constructions, turning over completed plants to these other divisions to operate. The present head of the Construction Division is Brig.-Gen. R. C. Marshall, Jr., a regular army officer and a man admirably fitted for this post. Under him, the personnel is made up almost exclusively of civilians, trained engineers and able business men, who took officer's commissions after our entry into the war, and by splendid team play built up, in the Construction Division, one of the most effective pieces of war machinery to be found in any country to-day. The several branches of the Construction Division are, (1) the Engineering Branch, under Col. F. M. Gunby, of Boston, a respected member of this Society; (2) the Construction Branch, under the joint charge of Col. M. J. Whitson, formerly of the Stone & Webster organization, and Col. Peter Junkersfeld, late of the Chicago Edison Company; (3) the Materials Branch, headed by Col. J. N. Willcutt, a well-known Boston builder; (4) the Legal or Contract Branch, under Col. Evan Shelby, a New York

lawyer; and (5) the Accounting Branch, under Col. Neville. Boston is well represented in the Construction Division by the officers named and by many others distributed throughout its personnel; indeed, those who have been in touch with Washington affairs during the war have been impressed with the active part Boston men are taking in all war activities — Bostonians are everywhere, and this city has reason to be proud of the important part her sons have taken in the larger problems of the war.

Returning again to the Boston Army Supply Base, the suggestions made by General Goethals on January 28 were studied by the speaker's firm, and on February 6 a report was made to the Construction Division and to General Goethals upon the latter's suggested scheme (Scheme A) and upon another scheme (Scheme B) for a development along the Reserved Channel, South Boston, on the site later purchased by the Government. Ledge rock in the harbor in front of the pier proposed in Scheme A was a serious objection to that scheme, not only in the matter of expense but particularly because of the time required for its removal, which would delay putting the plant into use for shipping purposes. Such geological information as was at hand indicated that ledge rock would not be encountered along the Reserved Channel, and after discussion it was decided by General Goethals that further study should be given to a development along the lines of Scheme B.

From the time that Scheme A was first suggested, on January 28, until the completion of the project according to Scheme Q was finally decided upon at Washington, late in May, a lot of time was spent in running down the alphabet with scheme after scheme worked out to meet the numerous suggestions and varying requirements of the many officials more or less directly concerned with this project. The augmented engineering staff of the speaker's firm worked day and night; and, by special dispensation from Washington, heatless Sundays and Mondays were unknown at their Boston office. Meantime, members of the firm were commuting weekly, sometimes oftener, between Boston and Washington. For a time it did seem as though "too many cooks would spoil the broth," but by April the pre-

liminary studies had proceeded to a point where it was found that, of the several schemes then under serious consideration, certain constructions near the middle of the proposed site were common to all. Accordingly, authorization was made in April of a part of the project, to the extent of about $14 500 000, and construction of the authorized portion of the storehouse was started April 22 without knowing what scheme would be adopted for the completion of the project. This partial authorization provided for the construction of four of the six sections of the main storehouse, of a corresponding length of wharf and wharf shed, and of railroad trackage, underground structures and other constructions common to the plans then being considered.

To show how readily Washington could change its official mind, it may be mentioned that the April authorization of the first part of the project provided for a storehouse six stories in height, and work on the foundations was started accordingly. Early in May, before these foundations were very far advanced, it began to look as though Washington would decide to increase the height of the storehouse from six stories to eight, and as the number of stories to be carried made some difference in the size of the foundations, those in charge of the project provided foundations for an eight-story building on the chance that the higher storehouse would later be determined upon. Their judgment proved to be correct, and in the second authorization for the completion of the Army Base, made late in May, the storehouse was fixed at eight stories in height by six sections in length. The second authorization, too, provided for a corresponding increase in length of wharf shed, in front of the storehouse, and authorized also the building of the navy pier and pier shed at the easterly end of the site.

The starting of construction before the entire undertaking had even been decided upon naturally made the preparation of the detailed designs a difficult and hurried matter. The contractors were right on the necks of the designing engineers, so to speak, and were insistently calling for plans all through the work up to the signing of the armistice, when overtime work on construction was stopped. At no time was an armistice necessary between the contractors and the engineers, however, for

the contractors were ever mindful of the difficulties which the war emergency imposed upon the preparation of the detailed designs, and they were at all times most considerate and most helpful to the engineers in their work.

In the building of the Boston Army Supply Base the Boston representative of the Construction Division of the Army is Major Charles R. Gow, past President of this Society, who as constructing quartermaster not only has full charge of the entire project but is responsible for all expenditures as well, all cheques for these expenditures bearing his signature. Assisting Major Gow is a staff of subordinate officers and a considerable office force, including the staff of the field auditor, who passes promptly upon all accounts right at the job, thus avoiding the red tape and delay incident to an audit at Washington. The principal contractor is the W. F. Kearns Company, and the leading sub-contractors are Holbrook, Cabot & Rollins Corporation, P. McGovern & Company, T. Stuart & Son Company, the Raymond Concrete Pile Company and the Bay State Dredging Company. The speaker's firm has had charge of engineering and inspection, this work including the making of all preliminary studies and detailed designs, the preparation of specifications, schedules and estimates, the engineering supervision of construction and field inspection, and the preparation of record and operating plans of the plant. The firm of Hollis French and Allen Hubbard, consulting engineers, was associated with the speaker's firm in the preparation of all plans and specifications for the heating system, including the boiler house.

Construction of the project, begun less than eight months ago, is now, on December 18, more than ninety per cent. complete and would have been finished by January had not the signing of the armistice materially slowed down the work. The total authorization for the project, made according to the preliminary estimates of the engineers, is slightly over $28 000 000, and it is expected that the project will be completed at a figure well within this estimate.

It may be noted that the Boston Army Supply Base was the first important war project of permanent character in which civilian engineers were called upon by the Army for full engi-

neering service, from the inception of the project through the stages of preliminary studies, detailed designs and engineering supervision of construction to the completion of the finished plant. Coöperation of the closest and heartiest kind was afforded these civilian engineers by the Construction Division at Washington, and the latitude allowed the engineers is shown by the fact that every plan made for the project was made by civilians and made in Boston.

Credit for the success and speed with which this work has been carried out is due to several important participants: first, to the Construction Division at Washington for the excellence of its organization on business lines, for its elimination of red tape, and for its national supervision of materials of construction such that the job was always kept supplied with the materials required; second, to the constructing quartermaster in direct charge of the entire undertaking, Major Gow, who, notwithstanding the tremendous responsibilities, has met so efficiently and so well every requirement of a general manager of a business of more than \$25 000 000 magnitude that it may frankly be said that a better selection for this important position could hardly have been made; third, to the remarkably able and efficient organization of contractors, principal contractor and subcontractors, perhaps as strong an organization of contracting resources and construction talent as has ever been gotten together in this country; fourth, to the staff of engineers and inspectors, who worked loyally days, nights and Sundays, at top speed, through many months, to insure the success of the undertaking; and especially to the resident engineer, Mr. George L. Mirick, who has met every demand made upon him with a spirit and resourcefulness worthy of special commendation; and, finally, to the splendid team play among all concerned — a coöperation remarkable for any big undertaking — a general feeling that the interests of all were common, not antagonistic, and that all were working for a single boss, — Uncle Sam, — for the single purpose of winning the war in the shortest possible time.

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BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

THE BOSTON ARMY SUPPLY BASE. — CONSTRUCTION FEATURES.

By Charles R. Gow,* Member Boston Society of Civil Engineers.

(Presented December 18, 1918.)

The title of "constructing quartermaster" is somewhat of a misnomer in this instance, because the official entitled to that designation was most fortunate in having assigned to him, as engineers and as contractors, individuals and firms far better qualified than he, both to design and to construct the many features embraced in this project. The functions of the constructing quartermaster, therefore, have so far been confined chiefly to that of official representative of the Government, with a view to coördinating the efforts of those employed in various capacities and to disbursing the funds appropriated for the work.

Having been engaged for approximately twenty years in the business of general contracting, it has been a distinct pleasure to the writer to assume temporarily the opposite rôle of owner's representative, and to exercise the powers and prerogatives which so often, in the past, have been used by others to effect his own discomfort. Incidentally, he has had occasion to verify

* Major Q. M. C., U. S. Army, Constructing Quartermaster.

Note. — Discussion is invited, to be received by W. L. Butcher, Editor, 715 Tremont Temple, Boston, Mass., before May 10, 1919, for publication in a subsequent issue of the Journal.

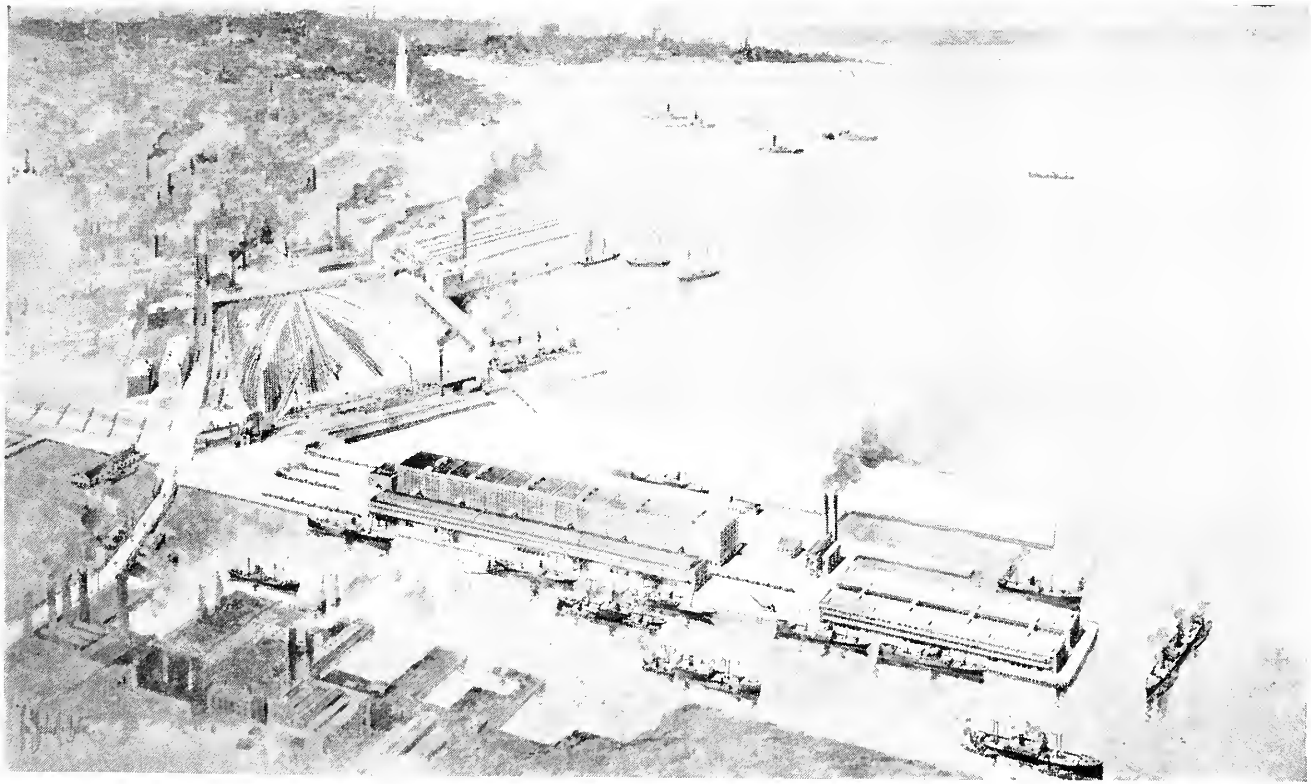

Fig. 1. General View of the Boston Army Supply Base.

a suspicion he has strongly entertained for many years, — that it is much easier to instruct others what to do and how to do it than it is to do it yourself. The contractors engaged upon this work have accomplished the desired results so much better, quicker and cheaper than the writer could have done under similar circumstances, that he has many times congratulated himself because to him were assigned the less difficult tasks of the constructing quartermaster.

Turning to the views of the work, Fig. 1 shows a perspective view of the entire project. At the left in the center background is shown the railroad yard, containing a little more than 11 miles of trackage, and allowing storage for approximately 750 cars of freight. The space covered by this yard is about 20 acres. It is located on land owned at present by the Commonwealth of Massachusetts, and is occupied under a permit granted to the Government by the Massachusetts Commission on Waterways and Public Lands. The small building in the left center foreground is the Administration Building, a four-story structure containing about 30 000 sq. ft. of floor area. Immediately to the right of this building is the Main Warehouse, 1 638 ft. long, by 126 ft. wide and eight stories in height. In front of and separated from the Warehouse by a paved street 87 ft. in width, is the Wharf or Cargo Shed, of similar length but only 100 ft. wide and two stories high. The Navy Pier Shed (so called) is shown at the extreme right, a twin structure 924 ft. long, each wing being 100 ft. in width and three stories high. Between the Warehouse and Pier Shed are seen the Power House and Electric Substation. There is a continuous wharf extending from the L Street Bridge, along the Reserved Channel for a distance of 4 100 lin. ft., to the end of the Pier Shed. If to this is added the apron along the east and north sides of the Pier Shed there is a total length of approximately 5 400 lin. ft. of wharf cap, or more than one mile. In order to provide adequate depth of water for docking and berthing vessels along this wharf, there is required the removal of about 2 800 000 yds. of dredging; 35 ft. depth has been provided for berthing space for the first 3 100 ft. in length along the Channel side, with only 30 ft. adjacent to the Pier Shed. There are approximately $6\frac{1}{2}$ miles of trackage

inside the main grounds, for the delivery of cars to the several portions of the project. In addition, there are complete systems of high- and low-pressure water supplies, sewerage and surface drainage, underground conduits for wires, etc.

When the site was purchased from the Commonwealth in April, 1918, it consisted of an undeveloped fill, partly of recent origin, containing approximately 37 acres and in addition about 20 acres of tidal flats. It has been necessary to raise the average level of the filled area about $4\frac{1}{2}$ feet over the entire lot. This has been accomplished by utilizing surplus excavated material and filling brought in on cars and barges.

Warehouse.

One of the most serious questions met with at the inception of the work was that of the desirable type of foundations to be adopted. As previously stated, the site consisted of reclaimed flats hydraulically filled, and this filling, in turn, overlaid a substantial depth of silt and other undesirable material extending to the clay at an average depth of twenty-eight to thirty feet below the surface.

The most important foundations were those required for the Warehouse (Fig. 2), the column loads of which in some instances exceeded 1 000 tons each. To use ordinary wooden piles would necessitate driving between 80 000 and 90 000 such piles under this building alone. This would require continuous spacing over the entire building area on two-foot centers. To cut off these piles at grade 9.00, in order to assure permanent saturation, would necessitate the removal of 50 000 cu. yds. of excavation and the introduction of a distributing mat of reinforced concrete to equalize loads on the several piles. The difficulties of obtaining such a large number of wooden piles in time, together with the expense and delay of excavating and concreting such large quantities, rendered this method prohibitive.

As an alternative, concrete piles were considered. If of the pre-cast type, the time required to make and cure them would condemn the suggestion. Built-in-place concrete piles

were practicable, but only one type was considered sufficiently dependable for so large a job, and this type could not readily be driven in the lengths required to meet these soil conditions.

As a last resort, the caisson type of pier footing was considered, and while the character of the underlying earth was not ideally suited for open excavation processes, it was found that

FIG. 2. THE WAREHOUSE.

this method of obtaining satisfactory foundations for the Warehouse gave greater promise, both as regards speed of construction and ultimate cost, than either wood or concrete piling.

Accordingly, it was determined to adopt the caisson type of footing, carrying down a circular concrete shaft 6 ft. in diameter until a sufficient penetration was obtained in the underlying clay, and to bell out in this material in the shape of a truncated frustum of a cone having inclined sides at an angle of 60 degrees with the horizontal, until a circular base of sufficient area to distribute the load safely was obtained.

It was assumed from an examination of test-boring samples of the clay that a unit loading of 5 tons per square foot at the

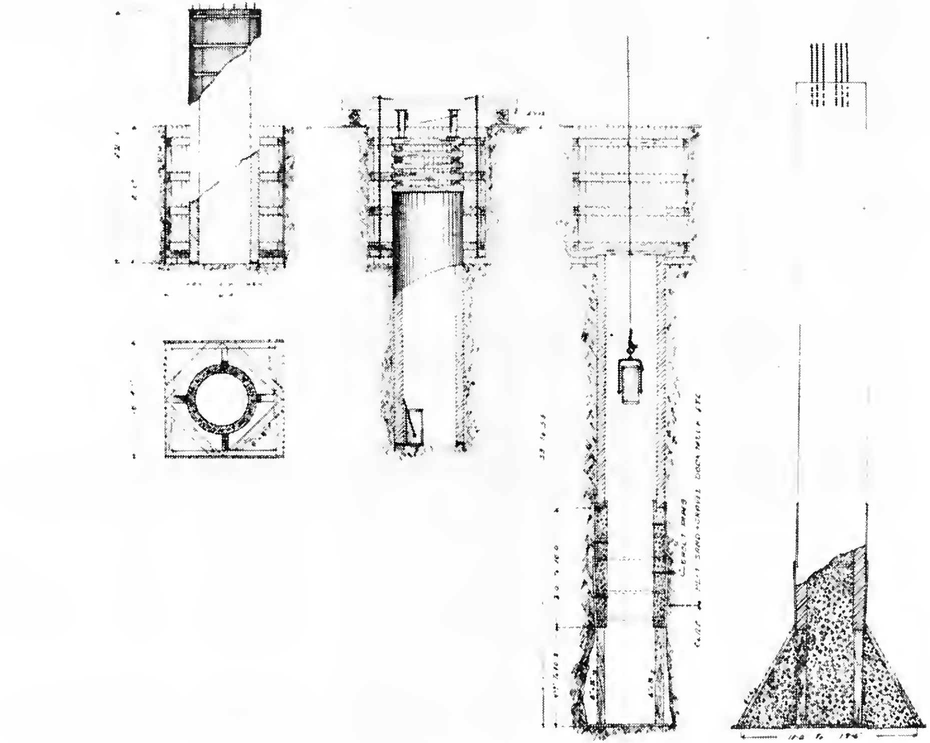

FIG. 3. METHOD OF CONSTRUCTING CAISSON PIERS.

base of the caisson footings would not be excessive, and their diameters were determined upon this basis.

The unit compressive stress in the concrete shaft was cared for by varying the concrete mix so that no unsafe limits would be reached. This method was deemed preferable to that of varying the size of shafts, because it allowed a standardization of forms.

The method of constructing these caisson piers is clearly illustrated by Fig. 3. An excavated sheeted pit, about 10 ft. by 10 ft. in plan and 10 to 12 ft. in depth, was first sunk and heavily braced. In the bottom of this pit, a steel cutting edge was accurately centered and leveled. Upon the cutting edge were then assembled an inner and outer set of circular wooden forms, similar to those used in casting large-sized concrete pipe. The outer form was exactly 6 ft. in diameter, while the inner form was 4 ft. 8 ins., thus providing for a thickness of 8 ins. of concrete shell. This shell could be carried up to any desired height, but usually not more than 21 to 22 ft. of shell were concreted at one time.

As soon as this concrete had sufficiently hardened, the outer form was removed, the concrete shell was securely braced to the sides of the open pit by means of four vertical guide timbers, and the sinking process begun. A laborer was lowered into the interior of the shell, who excavated from below the cutting edge, thus allowing the hollow shell to sink under its own weight. This process was followed as long as the shell continued to settle by gravity, usually for a depth of 10 to 15 ft., after which the surface friction between the exterior of the shell and the sticky clay filling became too great to permit further progress by this method.

Four short toggle timbers were then inserted diagonally across and under the corners of the lower set of braces in the open pit, and from these toggles heavy chains were brought up above the ground surface to engage two large jacking beams which served as reactions for four or more 25-ton ratchet jacks, thus increasing the apparent weight of the shells by this amount. (Fig. 4.) A further penetration of the shell was thus obtainable, until the upward pull on the toggles became sufficient to lift bodily the sheeting of the pit, at which stage, of course, no further

sinking was possible by this means. If the clay had not been reached in the meanwhile, it became necessary to poll down below the cutting edge, using short lengths of vertical sheeting which were held temporarily by interior circular rings. A sec-

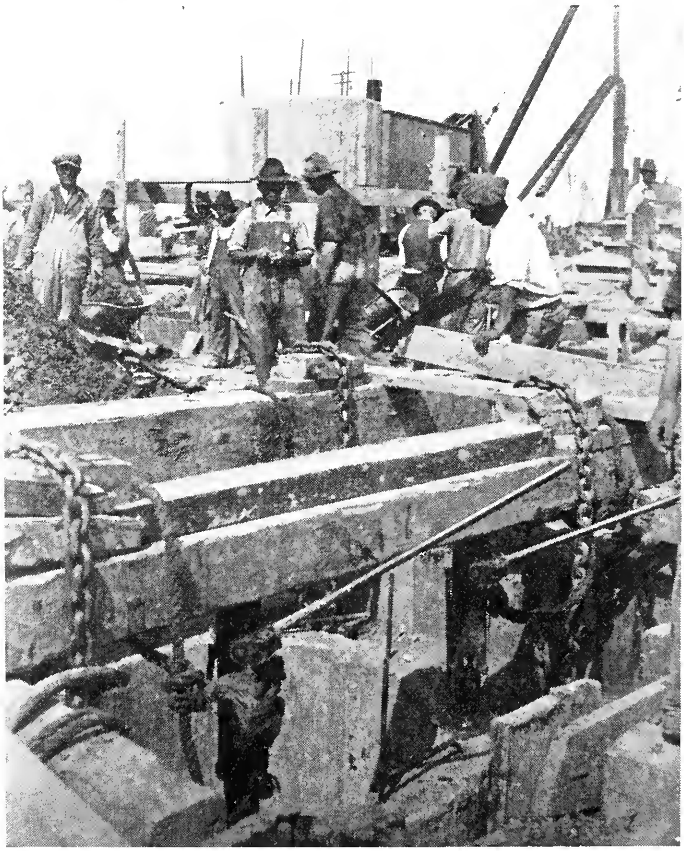

Fig. 4. Method of Forcing Down Caisson Shells.

tion of shell corresponding to the length of polling board used was then built in place, thus underpinning the section previously sunk and forming an extension thereto. This process was repeated until the clay had been reached, after which the bell was

excavated and braced as shown in Fig. 2. The final stage of the process consisted in filling the bell and interior of shaft with concrete, thus providing a solid monolith. Figs. 5, 6 and 7 are views of piers under construction.

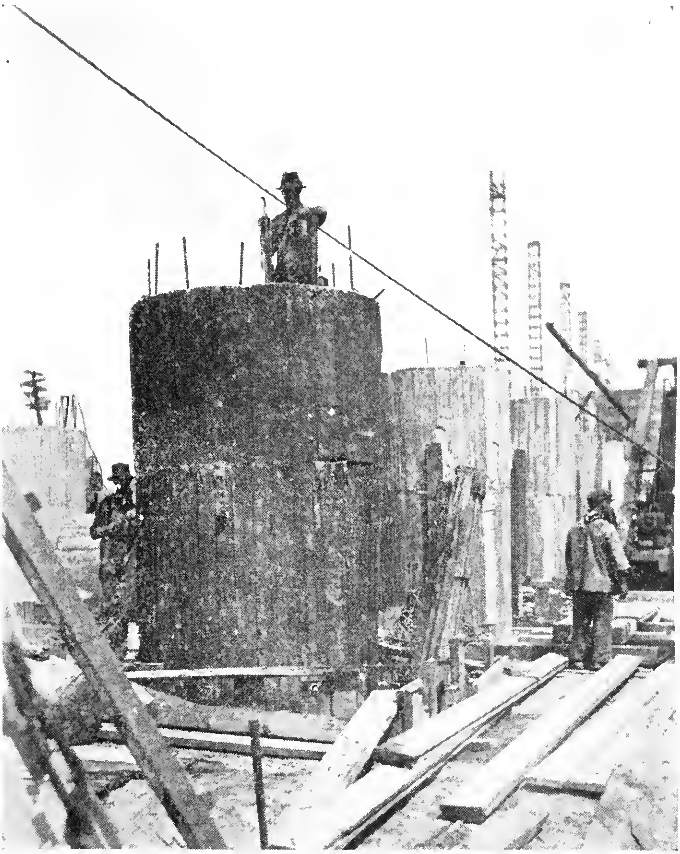

FIG. 5. PIERS UNDER CONSTRUCTION.

It was found necessary, in many instances, to carry these caisson footings as deep as 55 ft. in order to obtain satisfactory material in which to excavate the bell. Many of the footings gave trouble by reason of a tendency of the clay to flow under pressure from adjacent piers.

The general contractor, the F. W. Kearns Company, selected, as its subcontractor for this caisson work, P. McGovern & Company, of New York, a firm having a recognized experience and ability in handling heavy construction work below ground. The

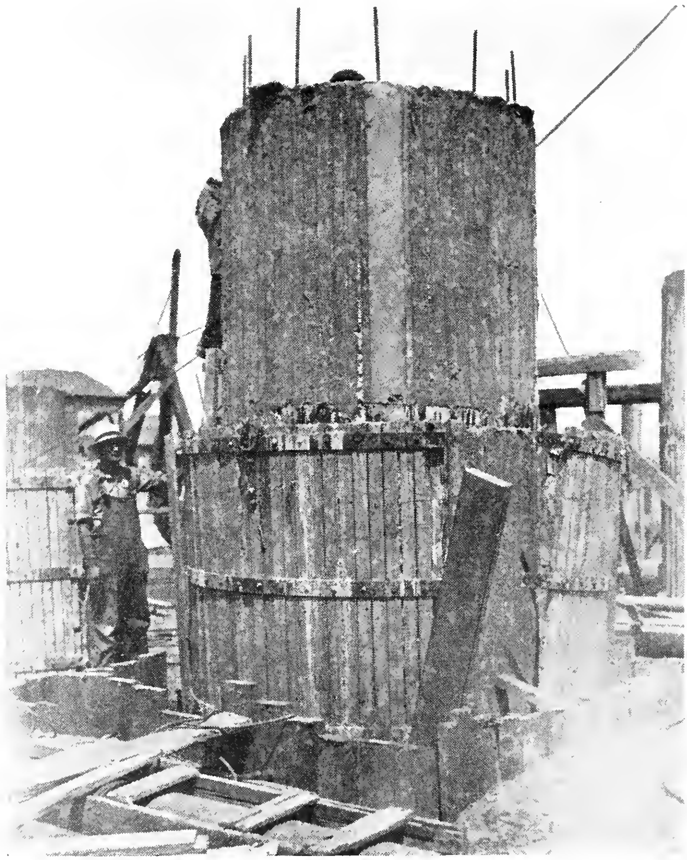

FIG. 6. PIERS UNDER CONSTRUCTION.

wisdom of this selection was fully demonstrated by the remarkable results obtained by this subcontractor. There were 577 caisson footings required, and ground was broken by the subcontractor on April 22. The progress schedule adopted required the

footings to be entirely completed by August 31. Despite the fact that the physical conditions governing this work were much more difficult than originally anticipated, the subcontractor turned over the last finished pier on August 10, three weeks

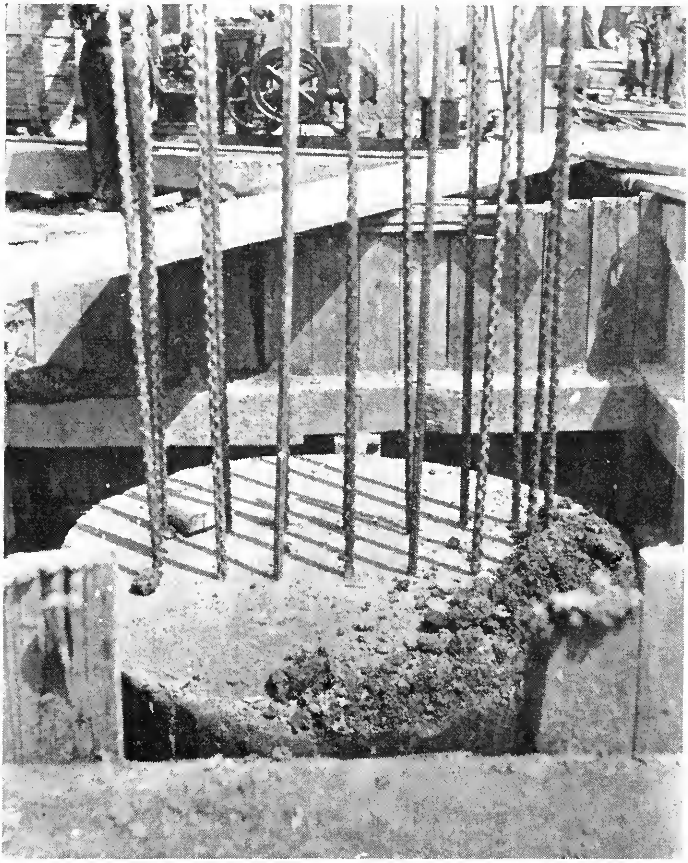

FIG. 7. PIERS UNDER CONSTRUCTION.

ahead of his schedule. This progress represented an average of five and two-thirds footings completed per day actually worked. The total amount of concrete involved was approximately 38 000 cu. yds. This remarkable progress under the most trying cir-

cumstances was due entirely to the exceptional resourcefulness, ingenuity and all-round ability displayed by the subcontractor's organization. Not only was this difficult work completed three weeks ahead of time, but was also finished within the estimate of cost originally allowed.

The superstructure of the Warehouse consists of reinforced concrete throughout, a total of 90 000 cu. yds. being required in its construction. The building consists of six sections — each 273 ft. long — in a continuous succession, individual sections being separated from their neighbors by a construction joint extending entirely through the cross-section except for the footings, which are common for the two abutting building columns. The first floor is designed for a live load of 500 lbs. per square foot, and all subsequent floors for 300 lbs. per square foot. All reinforced concrete designs are in accordance with the requirements of the so-called Joint Committee rules. The column spacing is 21 ft. by 21 ft., and all floors are of the flat slab type. The first story is 18 ft. in height, and subsequent stories are 14 ft. A twin tunnel runs the entire length of the building under the first floor, for the accommodation of steam pipes, electric conduits, etc. Along the north side of the Warehouse is an unloading platform 23 ft. in width, covered by a suspended canopy of reinforced concrete. Each section of the building is provided with a battery of four Otis freight elevators, each 9 ft. by 17 ft. and capable of lifting a load of 10 000 lbs. at a speed of 100 ft. per minute. These elevators are equipped with an automatic leveling device which adjusts them under all conditions to the exact level of any given floor. The elevator doors are all electrically operated from a central control station. A single passenger elevator of the A. B. See type serves each section of the building. All door openings on the first floor are 16 ft. by 12 ft., and are provided with full-opening Kinnear bifolding doors. The Warehouse is heated by a combination system of hot water circulated through the sprinkler system and by an auxiliary low-pressure steam system of wall radiation. Three stairways are provided for each section, with communicating doors on each floor between sections. A central partition divides each floor area of each section into a unit of approximately 16 000

sq. ft. The Warehouse is designed with a view to its ultimate use as a manufacturing building, and for this reason maximum window openings are provided.

Work on the superstructure of this building was begun by the general contractor, the W. F. Kearns Company, on May 24, and was completed on October 2, a total of 108 working days. This represents an average performance of 900 cu. yds. of con-

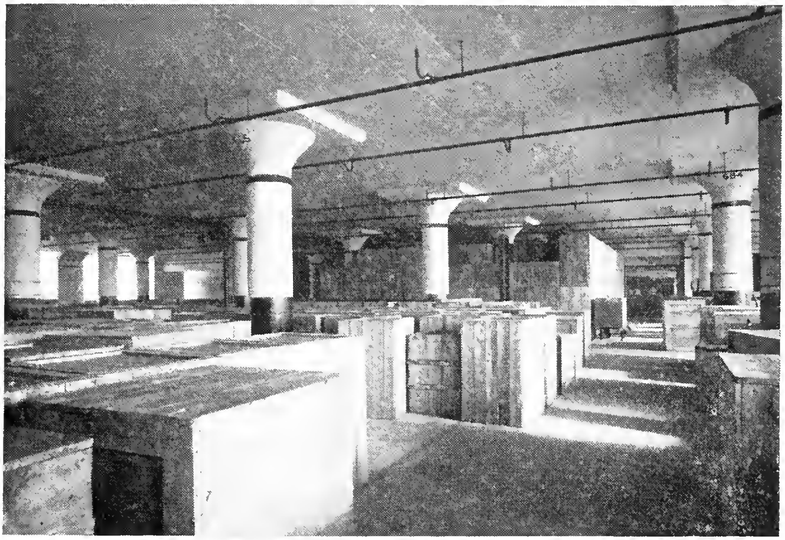

Fig. 8. Warehouse in Use.
Sixth Floor, Section E.

crete poured per day for this structure only, and probably establishes a record for progress on a building of this type. The estimated date of completion was November 30, so that the contractor exceeded requirements in this respect by fifty-nine days. Two construction towers, served by independent concrete mixers, distributed concrete to each section of building. Fig. 8 is a view of the interior as completed and in use.

An interesting feature of construction, and one which greatly facilitated progress, was the system of forms used, especially that for floor slabs. All form work was designed by the contractor's

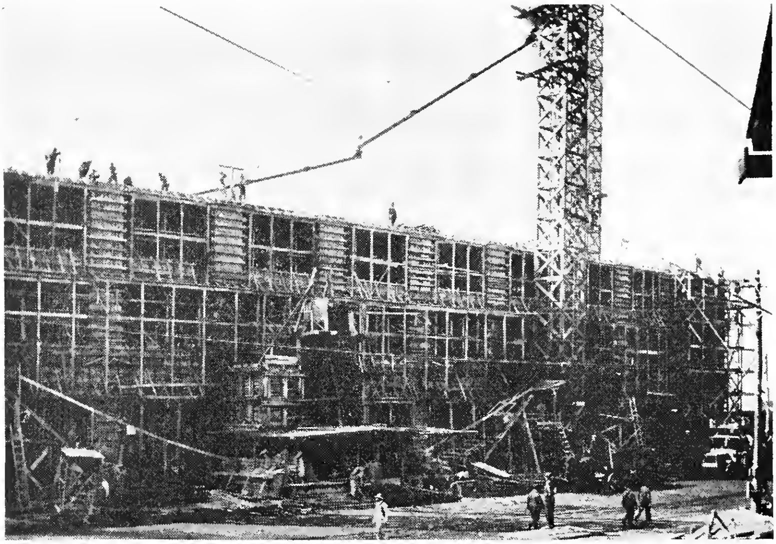

Fig. 9. Forms in Place.
Warehouse, Section F.

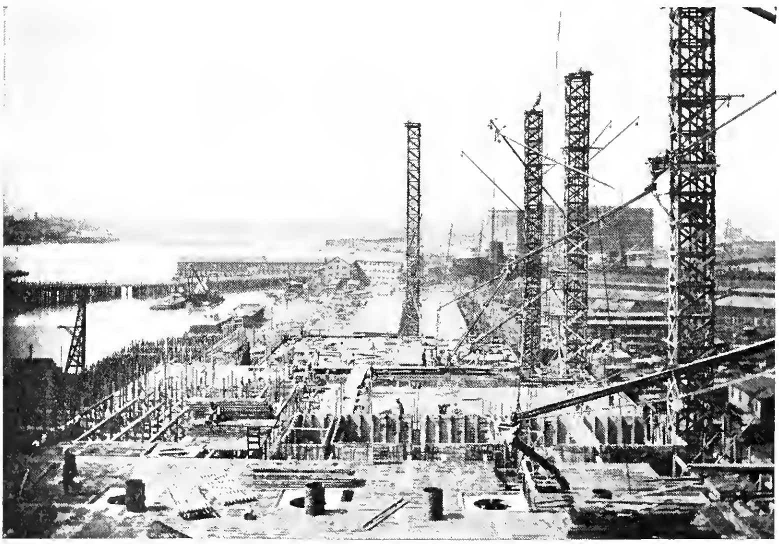

Fig. 10. Warehouse Floor Forms.

engineering force, was fabricated at a sawmill on the grounds, and was routed to position as required. The floor forms consisted of standard mats constructed of 2-in. by 3-in. pieces on edge, with separations between adjacent members into which the 2-in.

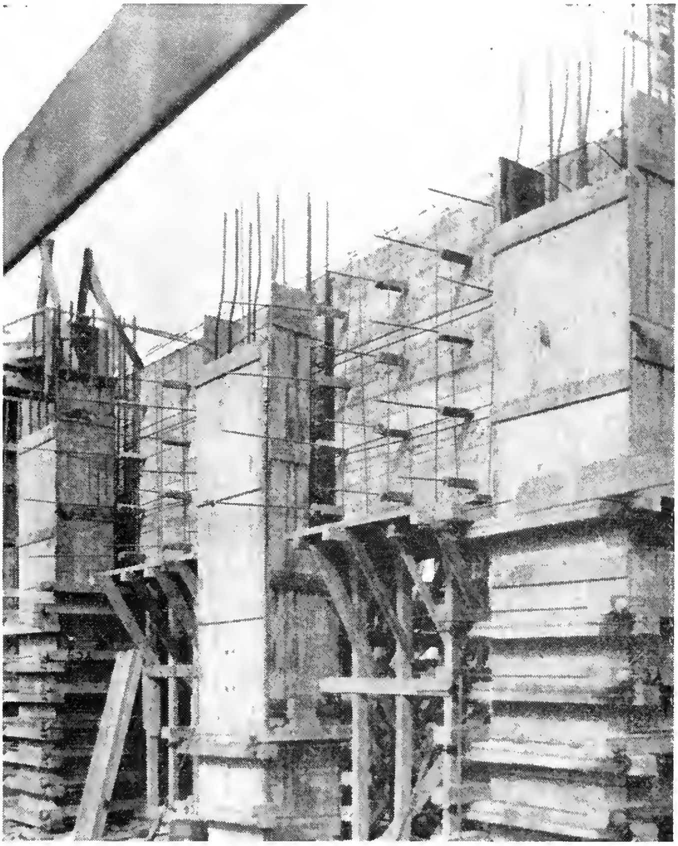

FIG. 11. WAREHOUSE COLUMN FORMS IN PLACE.

by 3-in. pieces of abutting mats could be telescoped, and thus provide adjustment of the longitudinal dimension without sawing or special fitting. A succession of these mats was laid over the area to be covered, supported upon 4 in. by 6 in. stringers, and over the top surface of the mats thus assembled was tacked

FIG. 12. PILING OF WHARF SHED PLATFORM.

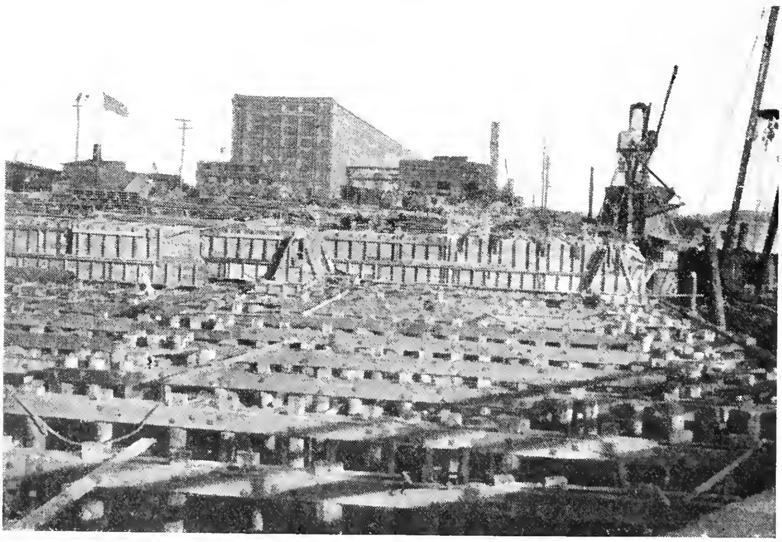

FIG. 13. WHARF SHED PLATFORM.

No. 22 gage sheet iron, which also could be lapped in any direction to cover a given space without cutting. The rapidity with which these forms could be assembled rendered them especially efficient. An idea of some of these forms in place may be obtained from Figs. 9, 10 and 11. Forms were made and placed for the eight stories of one section of the building, and when stripped they were moved forward horizontally into the next adjacent section. As each section was substantially typical, a set of forms for any one story could be moved to a corresponding position in the next section without alteration. Sheet-metal forms of circular cross-section were designed by the contractor for all typical interior columns.

The completed Warehouse contains approximately 1 600 000 sq. ft. of floor area and occupies about 23 800 000 cu. ft. of space.

Wharves.

There is a total of 10 acres of concrete wharf embraced in this project. A continuous wharf cap 5 400 ft. in length for the berthing of vessels is provided, 4 100 lin. ft. of which is in a straight line fronting on the Reserved Channel.

Under normal conditions it would probably have been practical to construct a quay wall along the face of this wharf and to have filled behind it, using spruce piling for foundations. The time allotted, however, in this case did not permit of this treatment, and it was determined to support these wharves, and such structures as they carried, upon piling driven in the water. It has been customary to use oak piles in Boston Harbor under such conditions, but, due to an excessive demand for oak piles on other Government work, it was impossible to obtain them in any appreciable quantity. As an alternative, the use of Southern pine piles was adopted. All piles were cut at the level of mean high water, or grade 10. It was assumed that cutting at this level would assure the continuous saturation of the piles. The question of possible worm action was considered, and an examination made of existing piling in the neighborhood, without finding any serious evidences of damage from this cause. All piles were driven with the bark on.

Fig. 14. West Open Wharf.

Fig. 15. Administration Building, Warehouse and Wharf Shed.

The piles were driven in transverse bents on 10.5 centers, with special clusters under building columns and other concentrated loads. As stated above, they were cut at grade 10, girder capped, and braced between high and low water, and transverse concrete girders 18 ins. thick, resting on the pile heads, were brought up to the under side of the 10-in. reinforced concrete slab which forms the wharf deck.

All of the wharf work was sublet by the general contractor to the well-known Boston firm, the Holbrook, Cabot & Rollins Corporation, which, by reason of its elaborate water plant and experienced organization, was able to complete the work well within the allotted time.

This work required the driving of 30 000 piles; the use of 2 000 000 ft. B.M. of hard-pine timbering; the placing of 41 000 cu. yds. of concrete, and the assembly of 1 200 tons of steel reinforcing. Figs. 12 and 13 illustrate the successive stages of wharf construction, and Fig. 14 shows the completed stretch of open wharf at the westerly end of the property.

Wharf Shed.

The Wharf Shed (Figs. 15 and 16) is two stories in height, with a monitor roof, the first story being 31 ft. 6 ins. and the second, to top of monitor, 29 ft. 8 ins. On account of the column spacing required, 21 ft. by 33 ft., together with the heavy live loads anticipated, the framework of the Wharf Shed is constructed of structural steel, the only concrete required being in the curtain walls and the floor slab of the second floor. The roof is constructed of plank on wooden purlins, and is covered with tar and gravel. The deck of the wharf, which forms the first floor, is designed for a live load of 600 lbs. per square foot, and the second floor of the Wharf Shed provides for a live load of 400 lbs. per square foot. The concrete wharf deck extends 35 ft. beyond the face of the Wharf Shed on the water side, making provision for the installation of two standard-gage tracks beside an additional track for the wharf cranes. Four thousand one hundred sixty-three tons of structural steel were required for the framework of this building, while only approximately 5 000

cu. yds. of concrete were necessary for the walls and floor. The Wharf Shed is equipped with five elevators manufactured and installed by the F. S. Payne Company, of Boston. Six over-

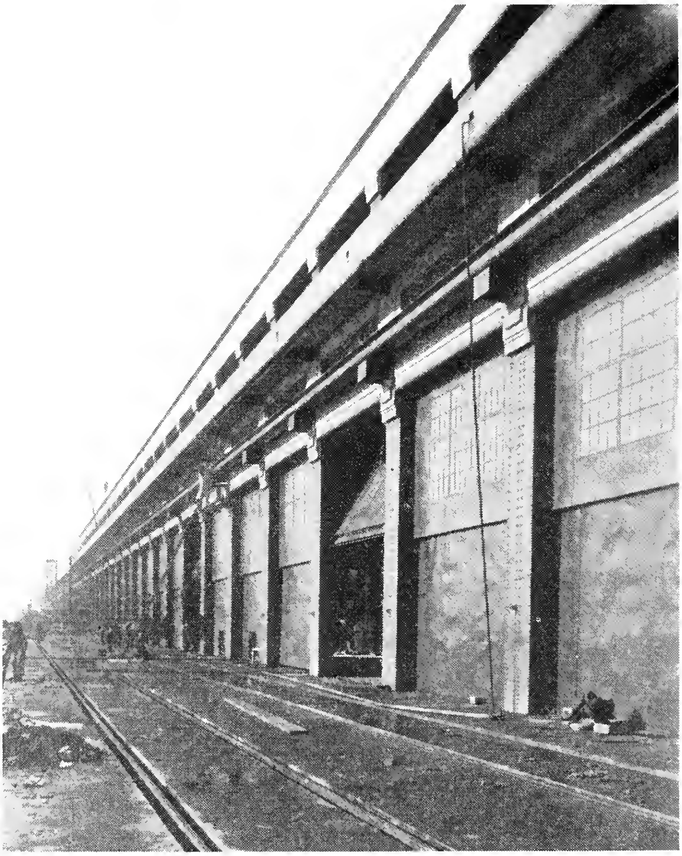

FIG. 16. WHARF SHED, SOUTH SIDE.

head bridges, one to each section, connect the second floor of the Wharf Shed with the third floor of the Warehouse, thus permitting cargo assembly of goods transferred from the six upper stories of the Warehouse without interference with traffic on Terminal Street, so called, this being the paved roadway

FIG. 17. PIER SHED.

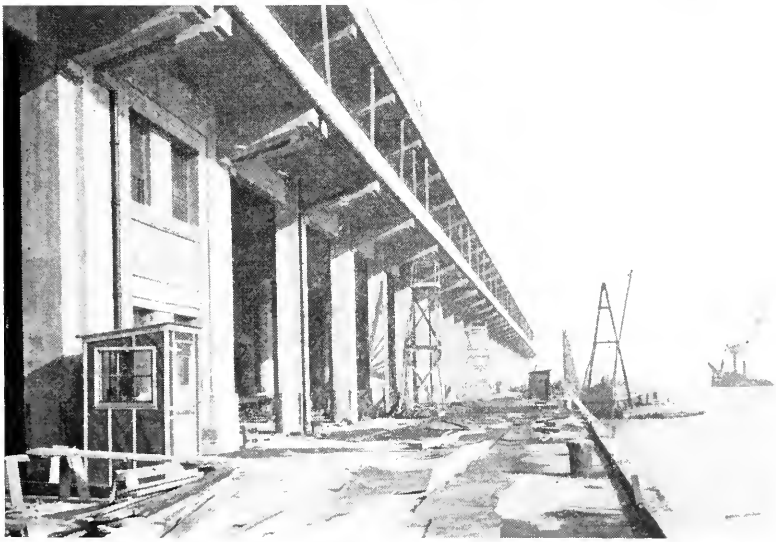

FIG. 18. PIER SHED, SOUTH SIDE.

FIG. 19. PIER SHED FROM SECTION "R."

FIG. 20. INTERIOR OF PIER SHED.

between the two buildings. A projecting balcony is provided at the second-floor level on the water side, for the direct transference of goods from this level to the ships, or *vice versa*.

The Wharf Shed is unheated, except for offices and toilets, and a dry pipe sprinkler system throughout is therefore required.

Two hundred and twenty-nine Ogden vertical-lift doors give access to Terminal Street and the wharf apron on the lower level, and to the open balcony on the upper level.

The structure of this building, containing 328 000 sq. ft. of floor area, was built by the general contractor in a period of ten weeks.

Pier Shed.

The twin buildings at the easterly end of the property, referred to as the Navy Pier Shed (Figs. 17, 18, 19 and 20), are expected to be used by the Navy as general stores for fitting out and repairing ships. It is also possible that it may be used in part as a receiving ship. The building is three stories in height, the first story being 24 ft. and the other two 14 ft. The column spacing is 25 ft. by 21 ft. and reinforced concrete is used throughout for the structural portion of the building, the same general type of construction being used as that adopted for the Warehouse. The available filled area at the site of this building was not sufficient to contain the entire length of the Pier Shed, so that the easterly 100 ft. is built over the tidal flats and is supported on wooden piles. The balance of the structure rests principally upon clusters of Raymond concrete piles, but the longitudinal outside walls are carried upon a continuous row of pre-cast concrete sheet piling, with some additional Raymond piles immediately in the rear of the sheet piling to carry partially the column loads.

The Raymond type of foundation was adopted for this building because it was found that hard bottom could be readily reached by this means, whereas under the Warehouse the greater depth prevented the use of this type of footing; 6 300 Raymond piles and 4 350 wood piles were required for the foundation of

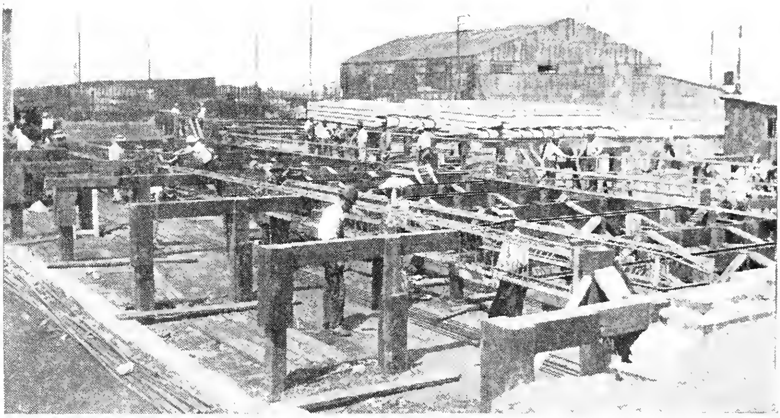

Fig. 21. Construction of Concrete Piles.

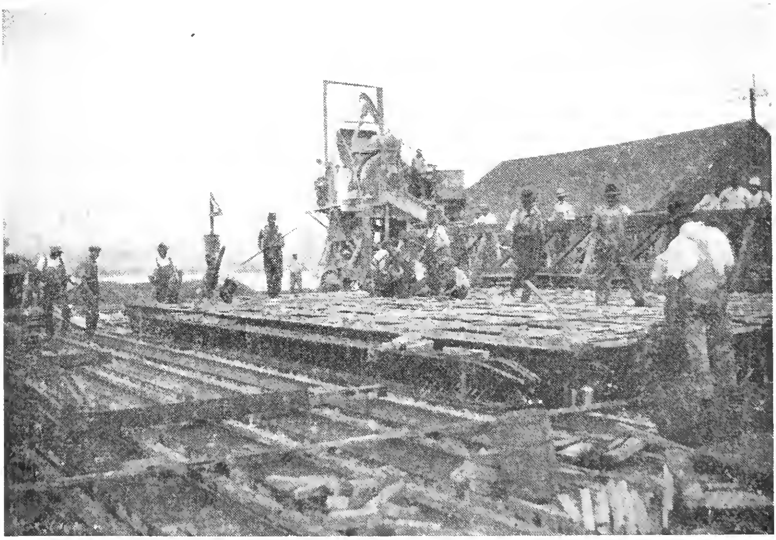

Fig. 22. Construction of Concrete Piles.

this building. The concrete piles are designed for a load of 35 tons each, and are the usual type of pile installed by the Raymond Company. The hydraulic fill forming the first 15 to 20 ft. of soil underlying the site was of very recent origin, and was of such a consistency that it was expected to flow readily unless confined. It was decided, therefore, before dredging for the required deep water adjacent to either side of this building, to

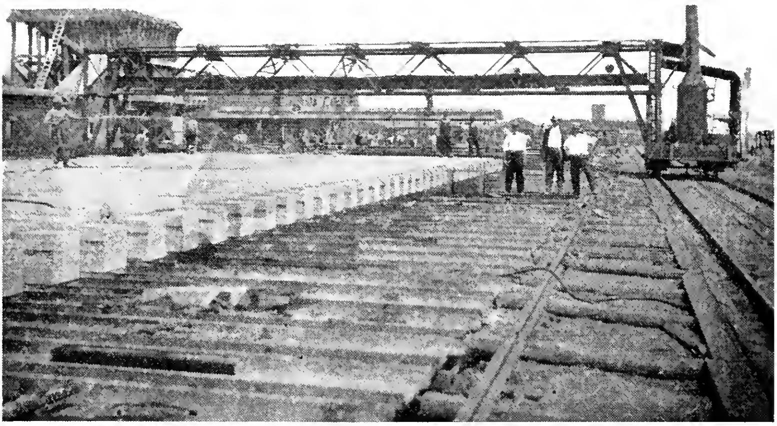

FIG. 23. CONSTRUCTION OF CONCRETE PILES.

drive a continuous row of reinforced concrete sheet piling which should operate as a retaining wall. The piles were pre-cast, were of 18 ins. by 21 ins. cross-section, and varied in length from 37 ft. to 48 ft. Individual piles weighed approximately $8\frac{1}{2}$ tons. They were made with a tongue and groove so as to lock together, and were driven by a 5 000-lb. steam hammer operated by a heavy land machine. Figs. 21, 22 and 23 illustrate the method of forming and casting these piles, in a special yard provided for the purpose on the South Boston side of the Reserved Channel. The contract for making and driving these piles was let to the Raymond Concrete Pile Company, and

Figs. 24 and 25 illustrate the process of handling and driving, while Fig. 26 shows a section of completed bulkhead. These piles were designed to act as vertical beams, being secured at the bottom by their penetration below the dredging line, and at

FIG. 24. HANDLING CONCRETE PILE.

the top by a tie system which extended entirely through the building and which bonded the heads of these piles into the floor system. The length of pile exposed to beam action is about 25 ft. A heavy distributing beam encases the tops of these piles

and constitutes the footing support for the outer walls of the buildings.

Three railroad tracks feed the two wings of this building through an open courtway running longitudinally between the

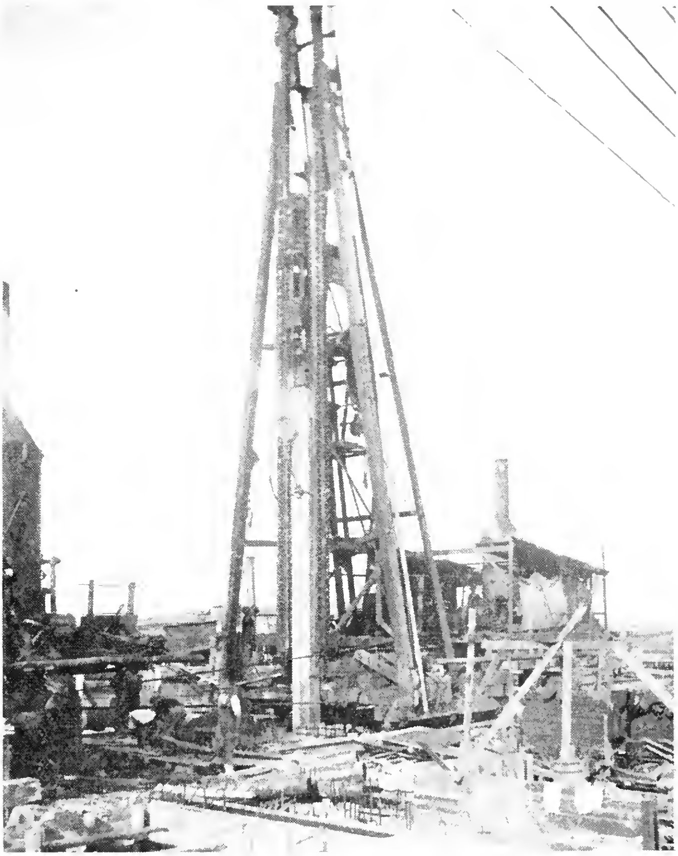

FIG. 25. DRIVING CONCRETE PILE.

two halves, while the water side is equipped with a concrete apron supported on wood piles, the deck being 28 ft. in width and containing a standard-gage track connecting with the yard system. A loading balcony is provided at both the second and

FIG. 26. SECTION OF COMPLETED BULKHEAD.

third floor levels on the water sides, to facilitate direct loading or receiving to and from ship. Cargo masts are to be provided, secured to the roof at frequent intervals, for the handling of freight.

There are 72 doorways communicating with the track platform, while the water side is provided with 166 Ogden vertical-lift doors.

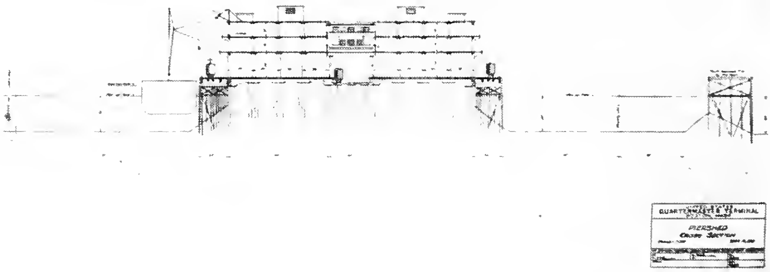

FIG. 27. CROSS-SECTION OF PIER SHED.

Eight freight elevators serve each wing of the Pier Shed, having a capacity of 12 000 lbs. each and a speed of 50 ft. per minute. The elevators of the south wing are of the Otis type, while those of the north wing are made and installed by the A. B. See Company.

The second and third stories of the Pier Shed are heated by a forced hot-water system, the water being heated largely by exhaust steam available at the Power House, and is conducted to the second story through insulated overhead pipe lines. The lower story is unheated.

A dry system of sprinklers is used throughout the building.

The concrete required for the superstructure of this building was poured by the general contractor in ten weeks.

Fig. 27 shows a cross-section of the Pier Shed illustrating the various features described above.

Power Plant.

Fig. 28 illustrates the Power House, a structure 80 ft. by 85 ft., and 78 ft. high. It is built partly upon wooden and partly upon Raymond concrete piles, the latter proving too short to reach good bottom under a portion of the building. The roof is constructed with a structural steel framework supporting the concrete.

The Power House contains six Heine safety boilers of 400 h.p. each, operated by forced draft and using mechanical stokers. The chimneys are twin stacks 165 ft. high and 9 ft. in diameter. An overhead coal bunker with a capacity of 700 tons, feeds coal through automatic weighing machines to the stokers. Coal is received by car, unloaded into an underground hopper, and elevated by means of a conveyer plant to the bunker. All ashes are removed by means of a steam jet conveyer to an overhead ash-pocket, from which they are delivered to cars for removal. The stokers are made by the Combustion Engineering Company, and the coal-handling apparatus is manufactured and erected by the Mead-Morrison Manufacturing Company, of Boston.

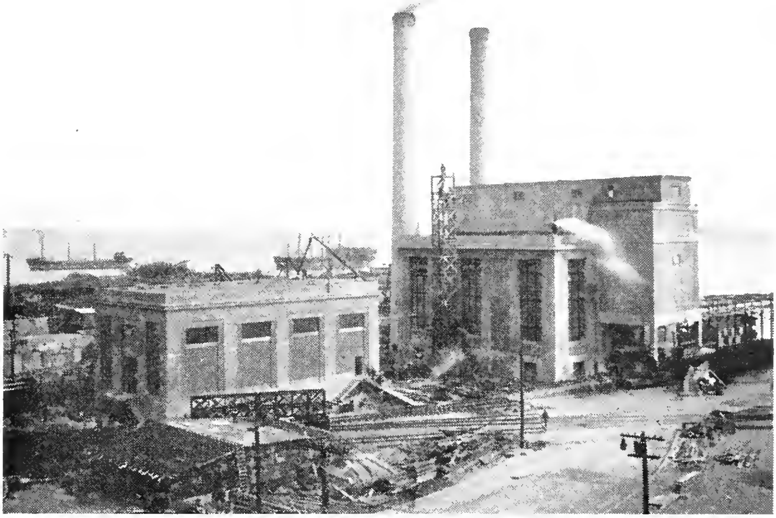

Fig. 28. Power House.

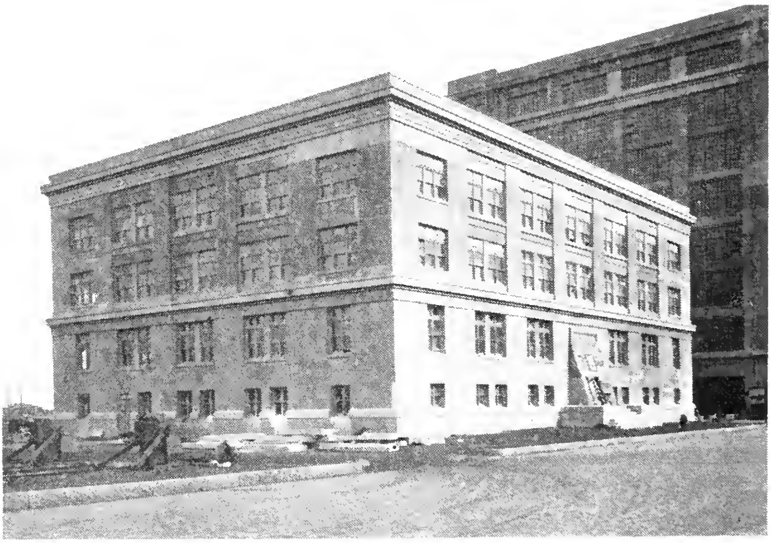

Fig. 29. Administration Building.

Electric Substation.

The Electric Substation consists of a building 86 ft. by 54 ft., containing one story and a basement. It is built of reinforced concrete with brick curtain walls, and will contain six 13 000-volt transformers, two 500 kw. rotary converters, and three switchboards. In the basement are located three motor-driven fire pumps of 100 h.p. each, and a motor generator set and storage battery equipment for operating remote control switches.

Administration Building.

The Administration Building (Fig. 29) is 122 ft. by 88 ft., of reinforced concrete, and consists at present of three stories and a basement, although the design contemplates a future addition of three more stories. It is built upon wooden piles, and is of reinforced concrete throughout with the exception of office partitions, which are built of terra-cotta. The basement will contain a first-aid room, telephone central station, officers' showers, etc. The first and second floors are divided for office space, while the top floor is intended for open desk space.

Railroads, Roads and Underground Work.

As previously stated, there are required approximately 18 miles of standard-gage railroad tracks. The Russian type of T-rail was adopted throughout, weighing $67\frac{1}{2}$ lbs. per yard. Although somewhat light, this type of rail was available in large quantity at the time work began, whereas the heavier types of rail could not be obtained in quantity in any reasonable season. Fig. 30 is a general view of the railroad yard.

There is a complete surface drainage system for draining the entire area occupied, and the railroad yard is drained by an independent system.

The sewerage system consists of a main sewer about 5 000 ft. long, and varies in size from 6 ins. to 18 ins. Connection was made with the city of Boston sewerage system at Summer Street and E Street. The capacity of the sewer at the point where it

FIG. 30. RAILROAD YARD.

FIG. 31. TERMINAL STREET.

leaves the Army Supply Base grounds is approximately 1.6 sec.-ft., and at the point of discharge is about 3.5 sec.-ft.

The water supply is taken entirely from the city of Boston system, by means of four independent extensions from that system, each line being 16 ins. in diameter. Two of these lines are low service, with a normal pressure of from 50 to 55 lbs. per square inch; and two are of high pressure, varying from 90 to 95 lbs. This arrangement provides for practically four independent sources of supply, reducing danger of interruption of service to a minimum. The high-pressure system is carried around the property in the form of a loop, with branches to the several buildings, and this system is depended upon to supply sprinkler systems, fire hydrants, wharf hydrants, and, if necessary, the domestic service such as plumbing, drinking and boiler feed. In case of failure of both high-service lines, the three electrically driven pumps in the Substation may be operated to maintain pressure on these lines within the grounds, drawing the water supply from the low-pressure system. The freight yard is also protected by a system of hydrants connected with the low-service line.

A paved roadway connects Terminal Street (Fig. 31) with Summer Street, and forms the main vehicle road to the premises. It is expected that Dry Dock Avenue, which is now laid out as a thoroughfare and which skirts the property immediately to the north, will be paved this coming season, and by means of cross-connections will establish a circulating medium for road traffic. All roads on the property are of granite block paving. It is expected eventually to provide a concrete base, but the installation of this base was not deemed desirable until after the ground has had an opportunity to reach its maximum settlement under traffic. Altogether, 28 000 sq. yds. of granite block paving are required.

All of the railroad, roadway and underground work has been sublet by the general contractor to the T. Stuart & Son Company, of Newton, a firm of engineering contractors well known in this locality for the many difficult and extensive contracts of that nature which they have handled. Although this work has not been of as spectacular nature as that involved in

some of the foundation and superstructure work, it is safe to say that without the energy, resourcefulness and all-round ability of this subcontractor, the completion of the work would have been greatly delayed. In addition to the work enumerated, this contractor provided and installed some 50 000 cu. yds. of ballast, laid 50 000 sq. yds. of wood block paving in the several buildings, constructed and operated a gravel and sand screening plant for the production of approximately 1 000 tons of concrete material per day, and in addition operated all of the railroad lines with respect to the receiving and delivery of freight consigned to the work. In this connection it is interesting to note that while approximately 7 500 carloads of freight were received for use in this work, not a single day's demurrage accumulated, and the average period of time required between the receipt and re-delivery of a car was approximately twenty hours.

Dredging.

In order to provide adequate approaches and berths for vessels in connection with the 5 400 lin. ft. of wharf frontage, there was required the removal of approximately 2 800 000 cu. yds. of dredged material. The contract for this work was awarded to the Bay State Dredging Company, of Boston, which company, besides supplying its own entire plant, arranged with three other dredging contractors for sufficient plant to remove the amount of material called for within the required period. The average daily progress maintained has been approximately 10 000 cu. yds., all of which material has been used by the Commonwealth for filling areas under development by them.

General.

The entire project was estimated, at its inception, to cost $28 000 000, and with the work 95 per cent. completed it now appears that the final cost will be well within that figure.

It was expected that the buildings would be ready for occupancy by January 1, 1919. As a matter of fact, the first goods were moved into the Warehouse on October 25 of this year. The Warehouse is now practically under full use, the Wharf Shed

is ready for occupation, and only a few weeks' work remains to be done on the Pier Shed before that also will be ready for use.

Credit for the successful carrying out of this enterprise is due primarily to the general contractor, the W. F. Kearns Company, which company has shown remarkable ability and wisdom in the organizing of the working force, the adoption of methods and the selection of subcontractors. A second contributing cause was the spirit of coöperation and the mutual team play which has existed from the beginning between the contractor, the subcontractors, the supervising engineers and the Government representatives.

Each of the contractors, as already noted, has discharged his duties in an exceptionally able manner, but this would not have been possible were it not for the splendid work done by the supervising engineers, Messrs. Fay, Spofford & Thorndike, and their very able field organization headed by Resident Engineer George L. Mirick. The preparation of detailed plans and the construction work started simultaneously. It was necessary, therefore, for the engineers to work faster on their design than the contractors were able to construct. In spite of this fact, there has been no serious delay at any time because of lack of detailed plans, and the engineering work has been so thorough in preparation and execution that the total sum involved in making changes due to mistakes or interferences on plans has not aggregated one thousand dollars on the entire work. The field organization, in addition to the usual duties, has prepared all schedules, established all lines and grades, inspected both materials and workmanship for quality, and exercised a general oversight of all details of construction.

Form of Contract.

The general contract and the subcontracts for foundations, wharfs, railroads and underground work, electrical, plumbing and heating work, were of the so-called "Emergency" type developed and used by the Construction Division of the Army, wherein the contractor is reimbursed by the Government for all direct expense incurred for labor and materials, and, in addition, is allowed a fee, the amount of which depends upon the total

disbursements but is figured at a decreasing rate as the cost increases. There is also stipulated in each contract a maximum fee, which is determined in advance, on the basis of an approximate estimate of the probable cost of the work. The largest fee allowable on any contract is $250 000, which normally would be earned under the sliding scale when $10 000 000 had been expended, and no greater fee is permitted, regardless of the total amount ultimately spent.

Thus, in this instance, if the estimated total of $28 000 000 expenditure were finally reached, the general contractor would earn his maximum fee at $10 000 000, and thereafter would be obliged to do the remaining $18 000 000 of work without profit. The average percentage of profit for the entire job in such a case would be about .9 of one per cent.

Inasmuch as certain overhead and establishment charges, including the cost of financing, are not included in the figured costs, it will be seen that the net profit to the contractor is even less than that stated.

The maximum fee allowable on subcontracts, as has already been stated, is fixed by a preliminary assumption of the anticipated cost of the work to be done, so that if the final cost exceeds the expected cost there is no gain to the contractor.

The largest rate of percentage used in estimating fees is 7 per cent., and this applies only to contracts involving an expenditure of less than $100 000. A gradual reduction in rate occurs up to the $10 000 000 limit, at which point the rate has been reduced to 2.5 per cent.

However opinions may differ as to the relative merits of this form of contract, it has proven most successful in this case. Each contractor has taken pride in keeping his costs within the original estimate, and has contributed his personal services freely and effectively for this purpose. In fact, the contractors have, in the main, shown quite as much interest in economy of expenditure as have the Government authorities.

On the other hand, the Government has had unrestricted opportunity to direct all features of the work as it might desire, to change plans or to add and deduct work without involving itself in claims, arguments or litigation.

It is safe to say that under no other form of contract could this work have been so quickly and economically completed.

The several contractors employed on the various features of the work were as follows:

Contractor.	Character of Work.	Approximate Amount of Contract.
W. F. Kearns Co.	Superstructure and general contract.	$28 000 000.00
Bay State Dredging and Contracting Co.	Dredging	1 000 000.00
William Bayley Co.	Steel sash.	10 000.00
Cleghorn Co.	Heating.	500 000.00
Detroit Steel Products Co.	Steel sash.	60 000.00
P. W. Donoghue	Plumbing.	250 000.00
John C. Finegan	Roofing.	75 000.00
General Fire Extinguisher Co.	Sprinkler work.	350 000.00
Holbrook, Cabot & Rollins Corp.	Wharves.	2 000 000.00
Kinnear Mfg. Co.	Steel doors.	76 000.00
Edwin C. Lewis, Inc.	Electrical work.	1 250 000.00
P. McGovern & Co.	Storehouse foundations.	1 500 000.00
Mead-Morrison Mfg. Co.	Coal-handling machinery.	40 000.00
New England Structural Co.	Structural steel.	400 000.00
J. Edward Ogden Co.	Steel doors.	400 000.co
Otis Elevator Co.	Elevators.	600 000.00
F. S. Payne Co.	Elevators.	50 000.00
Raymond Concrete Pile Co.	Pier Shed foundations.	1 500 000.00
Rust Engineering Co.	Chimneys.	12 000.00
A. B. See Electric Elevator Co.	Elevators.	92 000 00
T. Stuart & Son Co.	Railroads, streets and underground work.	1 750 000.00
Warren Bros. Co.	Bitulithic paving.	35 000.00
Consulting, Designing and Supervising Engineers.		
Fay, Spofford & Thorndike.		$500 000.00
Associated Engineers on Heating and Sprinkler Work.		
Hollis French and Allen Hubbard		$45 000.00

The work is being done under the jurisdiction of the Construction Division of the Army, of which Brig.-Gen. R. C. Marshall, Jr., is chief; Lieut.-Col. R. M. White, section chief in charge of terminals; Major Clinton F. Fisk, supervising constructing quartermaster; while the writer has served as constructing quartermaster on the job

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Boston Society of Civil Engineers
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PAPERS AND DISCUSSIONS

THE BOSTON ARMY SUPPLY BASE. — FROM THE CONTRACTOR'S STANDPOINT.

By William F. Kearns,* Member Boston Society of Civil Engineers.

(Presented December 18, 1918.)

It is, I think, needless for me to say that to Major Gow, more than to any other one man who is connected with the work in Boston, is due the great success of the job. In the early stages of the work, he was there at all hours of the day and night. Frequently he and I left the job at twelve and one o'clock in the morning, particularly in April in the first stages of the caisson work, which, as he has said, was quite difficult. It seemed at one time a very serious question whether or not we would ever be able to get those caissons down, but the Major stuck to the job, with Andy Cohill, chief engineer of the McGovern Company, and they got them down; but as he has already told you, he doesn't know anything about it.

In other matters, particularly in labor matters, if somebody doesn't get hold of him before the Government makes a contract with him, they will miss getting one of the greatest labor adjusters there is in the United States.

* Of William F. Kearns Co., General Contractors.

Note. — Discussion is invited, to be received by W. L. Butcher, Editor, 715 Tremont Temple, Boston, Mass., before May 10, 1919, for publication in a subsequent issue of the Journal.

When, as it frequently happened, we had a great many labor matters to settle, innumerable little questions coming up about the rights of the men on the job and where Union rules were invaded, the Major was there with the smile and a decision. Every Tuesday and Friday, we would have an evening session with the labor men.

As far as our associations with the architects and engineers were concerned, it was simply a pleasure to work with them. There could not be a more efficient organization. There could not have been a more ready response to our needs and requirements in the way of making plans, and sometimes, I confess, we may have been rather unreasonable in wanting plans before we were really ready for them.

I remember one evening we had a conference in the Major's office with the engineers, Mr. Fay, Professor Spofford and Mr. Thorndike, and we wanted a set of plans for some particular object. I think we wanted to get our forms made up ahead of time, or something of that kind, and I tried very hard to get a promise from Mr. Fay as to when we would get the plans, and Mr. Fay had almost fallen for it, when Professor Spofford stepped into the breach and said, "Don't you promise him anything. If you say one week, he will be after them to-morrow and you will have to give them to him."

Referring to our own organization, we were, of course, a comparatively small building concern when we started and we had a force capable of handling, by working hard, probably a million dollars' worth of work a year, when we were confronted last April with the project of a twenty-eight million dollar job. It was some proposition to build up an organization to meet the requirements. I must say we did not need to advertise for the men to fill the jobs.

There were plenty of volunteers. In fact, I think there were over five thousand. It was rather difficult even then to select from such an enormous number of applications, but we did finally put together an organization, the whole theory being to place some individual in charge of a certain given piece of work and not interfere with him so long as he carried on that piece of work efficiently, but the moment we saw signs that he was

breaking down, or that that particular piece of work was going badly, there was an immediate change.

We had a wonderful organization; the results obtained were, I think, remarkable; and I will say this for the organization as it has stood during the last three or four months, including all the subcontractors that we selected to do the work — that if I had to do the work all over again or start a similar job, I would not make a single change in any department, particularly the subcontractors. Every one carried out more than they were asked; every one of them gave the greatest support to the constructing quartermaster and the contractor; everybody worked with the one idea of getting the work done. They did not stop to argue about it. They simply got their orders and they carried them out cheerfully and loyally.

I expected, in bringing together so many organizations, as we did, to see a great deal of friction — and it was amazing how little there was. Every organization carried out its own work and at the same time coöperated with others with whom they came in contact.

The same thing held true throughout our own organization. The employees of the Quartermaster's Corps, of which there were three or four hundred, coöperated splendidly with us and helped us in every way possible.

The Inspection Corps of the engineers were never unreasonable, and they seemed to have the idea that it wasn't a place for faultfinding, — rather it was a place for constructive criticism and assisting the contractors, and they carried that spirit throughout the job.

One of the greatest things that was put into effect there — and I think to Major Gow is due the most of the credit — was the timekeeping system. A card was issued, which was marked into squares, indicating the morning and afternoon hours. As the man passed through the turnstile the card was time stamped. When he reached the job, the foreman of the gang to whom the man was assigned punched the ticket. During the middle of the forenoon, or in the course of the forenoon, the Government timekeeper punched the card again, to show that the man was on his work. Some time in the afternoon, the Government

checker punched the card again; a few minutes before quitting time the foreman again punched the card; and then it was finally time stamped at the gate as he left.

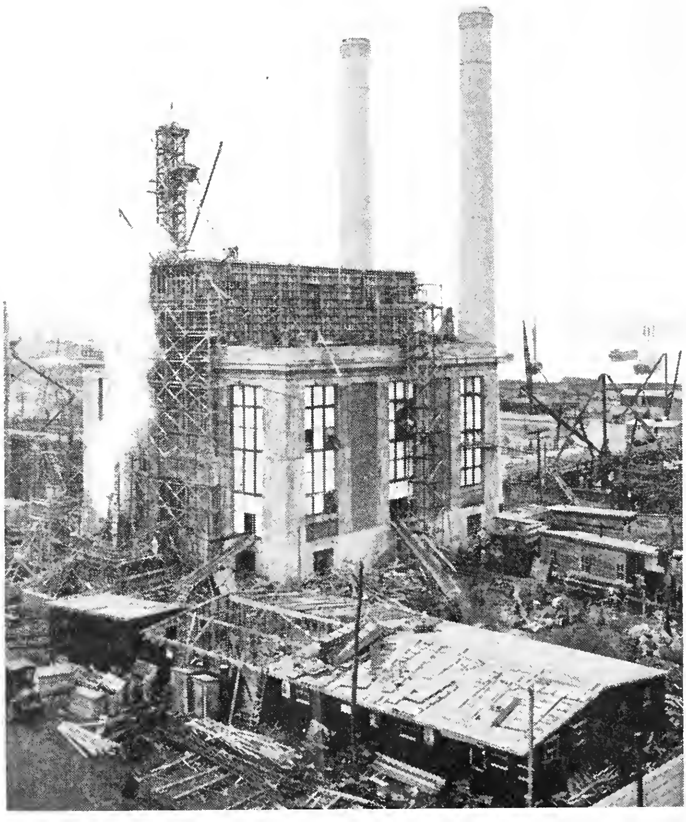

FIG. 1. POWER HOUSE UNDER CONSTRUCTION.

So, practically at every hour of the day, we had a record of every man on the job, and I think there was less trouble in timekeeping on this job than on any similar job I have ever seen. We had a complete daily record of each man through the different punch marks, each foreman having a different die. By this

method we knew just which foreman he was working under, and knowing the foreman, we, of course, knew the kind of work he was doing, so that when the cards were turned in they assisted not only in keeping the time, but in making up the cost records.

The dredging item has not been touched upon, not through any desire not to give credit, I am sure, but possibly other points of interest were more in the speaker's mind. I want to give credit to the Bay State Dredging Company for the remarkable work that they have done in the dredging. They certainly have accomplished wonders, and it looks now as if they would be able to beat us in finally cleaning up on the contract, although at one time they thought they would be on the job two or three months after us.

There are just a few pictures that the gentleman who did not know anything about the construction left for me to explain. Fig. 1 shows the power house, with the stacks above. There wasn't very much to this, except at one time a little difference of opinion as to whether the Greek style of architecture or Italian Renaissance would be the best to use. I think it was finally decided to stick to old colonial.

The power-house installation consists of six 400 h.p. Heine water-tube boilers, equipped with steam-driven automatic stokers and forced draft fuel economizers guaranteed to operate the boilers at 150 per cent. of their normal rating.

Fig. 2 is an interesting picture which illustrates very forcibly the speed with which the work was carried along. In the background of the photograph on the left can be seen, about one half concreted, the eighth floor of Section C of the main warehouse; the fourth floor of Section D in about the same condition; the first floor of Section E about completed, and Section F just started. That was the condition of the Warehouse on August 22.

On October 2 (Fig. 3), just thirty-five working days later, the roof of Section F was fininshed, completing the concrete structure of the main Warehouse. In other words, twenty-four floors completed in thirty-five days.

This undoubtedly is the fastest piece of concrete construction on record. It must also be taken into consideration that the main objective on this work was the speedy prosecution of

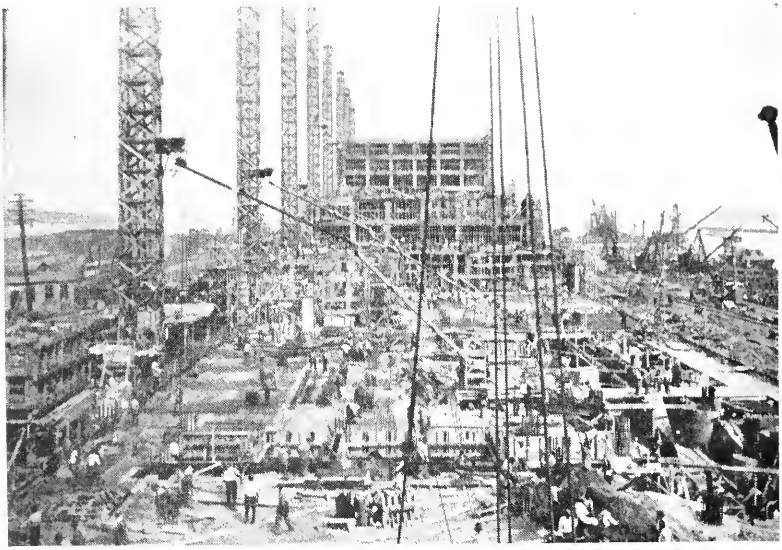

FIG. 2. WAREHOUSE UNDER CONSTRUCTION (AUG. 22, 1918).

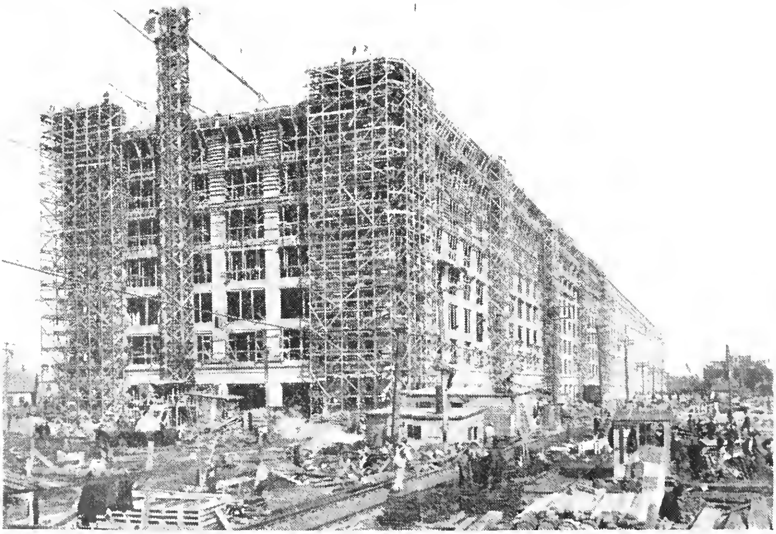

FIG. 3. WAREHOUSE NEARING COMPLETION (OCT. 2, 1918).

the project as a whole, and not the concentration of the working forces on one item of the construction alone at the expense of others, so that although a magnificent showing had been made on the concrete work, when that was done, there remained not an empty shell of a building, but everything necessary to complete the entire work. So that on October 23, or three weeks later, the Government took possession of a large portion of the Warehouse, with its railroad facilities, paved roadways, wharf and wharf shed, as a storage base for millions of dollars' worth of wool. This is a record of which we are justly proud.

I think the speed on the work is due more than anything else to the method of forms that we used, as it is very well known that rapid concrete construction is generally dependent on the quickness with which the forms may be fabricated, erected and stripped. With this in mind we studied our form work very carefully, and instituted very successfully two radical changes in the usual method of form building.

In the first place, the study of the difficulties involved in the foundation work of the Warehouse revealed the fact that there probably would be three to four weeks between the completion of the caisson work on the first and second sections, and at least three weeks between the second and third, and so on through the remaining sections, the interval being cut down, as the work developed over more area, never getting less than a week or ten days. Taking advantage of this construction feature, we built a complete set of forms for every floor in Section A; then, in the interval, before the next section was ready, we stripped the completed section and moved the forms horizontally to the same floor of the section ready to be formed.

By working this way, we eliminated rebuilding the form work, as would have had to be done to meet the various requirements of the different floors if the forms had been moved up; we saved the cost of the labor that would have been necessary for such movement, and, in addition, there was a saving of at least a million feet of lumber.

Our second change was necessitated by the confined working space at the site of the building. On account of this, it was necessary to construct all the forms at a central mill, and dis-

tribute them to the work complete in every detail, so that the men on the buildings were merely erectors, in fact, the fabrication and erection of all the form work was handled exactly as is structural steel in a building or bridge.

The forms were marked at the mill where they were fabricated, to correspond with the key or erection plans prepared by our form-design department. Columns carrying the mark "C" and their designating number; beams, "B," beam bottoms, "BB," etc. Thus when the forms were delivered at the job, a glance at the key plan told the foreman exactly where the pieces were located, and a very small organization kept the mill constantly informed just what was wanted at each particular part of the job, so that pieces not needed for some little time were not lying around and going astray. In addition, this system of form handling avoided all confusion in moving the forms from one section to another, as typical pieces carried the same mark through the entire construction. Therefore it made no difference from what part of some other building a foreman secured his form, if it carried the marking of the piece he wanted, it fitted his work. Then again, in case a piece was destroyed in stripping, the mill was notified of the number of the piece, and a new one was made and sent to the work.

In the design of the form work, we used the same method of flat slab centering which we have found very economical in our previous experience. The typical floor frame consists of wooden mats 2 ft. 6 ins. wide by 12 ft. 0 in. long, made up of 2 by 3's placed 5 ins. on center and covered with 20-gage black sheet steel. These mats are supported on 4 by 6 girts approximately 5 ft. on center, and the girts held up by 3-in. by 4-in. posts, 5 to 6 ft. on center according to requirements of the work.

This type of framing, if well made up so as not to be racked and twisted when stripped, can be used at least ten times, and the sheet metal which is rolled after each usage is good for twelve to fifteen uses. The exterior column forms were constructed of 2-in. spruce plank, and special care was used in their fabrication so that the forms would be extra strong; and with very few exceptions, these forms were used in all the sections of the Warehouse, making in all about six times that they were set up. On

the interior round columns, we were able to add to the general appearance of the interior of the building and at the same time effect considerable economy by manufacturing our own metal column forms instead of leasing the ordinary commercial product.

I think the Major has covered the rest of the ground so well that there is nothing really of any importance left for me to say. I want to thank you all for your attention, and hope that we shall have another job, later on, that, while possibly not quite so big, will give us a chance to show that we can speed up even a little more.

Vol. VI MARCH, 1919 No. 3

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

THE BOSTON ARMY SUPPLY BASE. — GENERAL DATA.

By Charles M. Spofford,* President Boston Society of Civil Engineers.

(Presented December 18, 1918.)

Purpose. — The Boston Army Supply Base was designed for storage and shipment of overseas army supplies. It may be used in times of peace as a base for the Emergency Fleet, and the large Storehouse is suitable for either manufacturing or storage.

Location. — The Boston Army Supply Base is located at South Boston, on the southerly side of a strip of filled land lying between the "Reserved Channel" and the main ship channel and adjoining the Commonwealth Dry Dock. The entrance to the site is on Summer Street Extension and is about one mile from the South Station from which it is reached by street car. There is a short and easy approach from the open sea by the main ship channel to the "Reserved Channel."

Area of Site. — The site consists of 57 acres. Before construction began, 37 acres of this was filled land and 20 acres water-covered flats.

Buildings. — The principal buildings are the Storehouse, Wharf Shed and Pier Shed. Minor buildings are the Boiler House, the Electric Substation and the Administration Building.

* Of Fay, Spofford & Thorndike, Consulting Engineers, 308 Boylston St., Boston, Mass.

NOTE. — Discussion is invited, to be received by W. L. Butcher, Editor, 715 Tremont Temple, Boston, Mass., before May 10, 1919, for publication in a subsequent issue of the JOURNAL.

The Storehouse is an eight-story reinforced concrete building, 126 ft. wide and 1 638 ft. long. It is divided into six equal sections, separated by fire walls, with provision for expansion between sections, and is so constructed and equipped that it may be used for either manufacturing or storage. The lower floor has a wood block pavement, and all other floors have granolithic surfaces.

The Wharf Shed adjoins the Storehouse on the southerly side and is connected to it by six bridges, one at each section of the Storehouse. Between the Storehouse and the Wharf Shed is an 87-ft. paved street called Terminal Street, the surface of which is flush with the lower floors of both the Storehouse and the Wharf Shed. The Wharf Shed is a two-story structure, 100 ft. wide and 1 638 ft. long, with steel frame and concrete curtain walls. The balcony at the second-story level permits of transference of freight between this floor and the ship. One of the rails for the semi-portal gantry cranes which are to serve the Wharf Shed is located below the balcony. The pavement on the lower floor is wood block; on the upper floor, bitulithic, and on the balcony, concrete.

The Pier Shed is located at the easterly end of the property and is intended to be used for naval stores. It consists of two three-story reinforced concrete parallel buildings, each 100 ft. wide by 924 ft. long and connected by bridges at the second and third floors. The depressed way between these buildings has a net width of 37 ft. and provides for three railroad tracks; inclined ramps furnish access to ground floors of buildings. The Pier Shed buildings have balconies at the second and third floors on the sides adjoining the water, so that freight may be transferred directly between either of these floors and ships.

Floor Areas (measured to building line). —

Storehouse —	8 floors @ 206,388 =	1,651,104 sq. ft.
Wharf Shed —	1st floor @ 163,800 = 2d floor @ 154,960 =	318,760 sq. ft.
Pier Sheds —	3 floors @ 184,800 =	554,400 sq. ft.
Total		2,524,264 sq. ft.

Net Floor Area in Typical Cases. — Percentage reduction in typical floor areas due to various causes:

	Storehouse. All Floors except 1st and 3d.	Wharf Shed. 2d Floor.	Pier Shed. 2d and 3d Floors.
Walls	1.6	0.2	1.9
Columns	0.9	0.1	0.4
Pipe shaft	0.5	0.0	0.0
Radiators, piping, etc.	0.6	0.5	0.9
Freight elevators	3.0	1.1	2.5
Turning space around freight elevators	12.8	4.9	7.9
Passenger elevators	0.2	0.0	0.0
Stairways	1.9	0.9	0.9
Offices	0.0	1.0	0.0
Toilet	0.4	0.0	1.4
Totals	21.9	8.7	15.9
Aisles — as laid out for maximum storage (one kind of goods only per section floor),	11.9	20.9	22.7
Aisles — as laid out for miscellaneous storage	20.4	25.2	25.8

Total Floor Areas Available for Storage (maximum area after deducting for aisles, assuming only one class of goods stored per section floor and consequently a minimum number of aisles).—

Storehouse	1,071,000 sq. ft.
Wharf Shed	227,000 sq. ft.
Pier Sheds	341,000 sq. ft.
Total	1,639,000 sq. ft.

Story and Building Heights. —

Storehouse — Lower story, 16 ft. 0 in. floor to ceiling.
14 ft. 0 in. floor to sprinkler pipes.
Other stories, 13 ft. 0 in. floor to ceiling.
11 ft. 0 in. floor to sprinkler pipes.
Total height of building — End sections
115 ft. 6 ins. lower floor to top of roof (average).
118 ft. 11 ins. lower floor to top of cornice.
122 ft. 9 ins. lower floor to top line of parapet.

Wharf Shed — Lower story, 30 ft. 11 ins. to underside of slab.
29 ft. 3 ins. to underside of beams.
27 ft. 0 in. to underside of girders.
Sprinkler pipes are above bottom of girders.
Upper story, 20 ft. 7 ins. to underside of roof planking.
19 ft. 7 ins. to underside of purlins.
18 ft. 0 in. to underside of roof beams.
Sprinkler pipes are above bottom of roof beams.
Total height of building — 61 ft. 3 ins. lower floor to top of monitor.

Pier Sheds — Lower story, 24 ft. 0 in. floor to ceiling.
22 ft. 0 in. floor to sprinkler pipes.
Other stories, 14 ft. 0 in. floor to ceiling.
12 ft. 0 in. floor to sprinkler pipes.
Total height of buildings —
55 ft. 3 ins. lower floor to top of roof (average).
56 ft. 2 ins. lower floor to top of parapet.

Windows. — The Storehouse has 744 large windows, each 16 ft. $1\frac{1}{2}$ ins. wide and 10 ft. $3\frac{1}{8}$ ins. high; Fenestra steel sash is used, with factory ribbed glass at ends and north side and rough wire glass on the south side. Panes of clear glass are inserted in the lower portions of each window, and 18 per cent. of the total window space is provided with ventilating sashes. The Pier Sheds have a total of 244 large windows on the north and south sides, each opening being 18 ft. 0 in. wide and 5 ft. 2 ins. high; Fenestra steel sash and rough wire glass with occasional panes of clear glass are used and 13 per cent. of the total window space is provided with ventilating sashes.

The Wharf Shed has 142 large windows on the north and south sides of the second floor, with openings 16 ft. $1\frac{1}{2}$ ins. wide and 6 ft. $10\frac{3}{8}$ ins. high. The sash is the Bayley Springfield type, with factory ribbed glass and without ventilation.

Bifold metal freight doors in all of the buildings are provided in the upper half, with wire glass lights.

Freight Doors in Main Buildings. — All doors are of steel. All bifold doors have wire glass lights in upper sections.

Storehouse:

Location.	No. of Doors.	Type.	Size of Opening. Width.	Height.
Lower floor — south	56	Kinnear bifold.	16 ft. 1½ ins.	12 ft. 0 in.
Lower floor — north	56	Kinnear bifold.	16 ft. 1½ ins.	12 ft. 0 in.
Lower floor — south	6	Kinnear bifold.	13 ft. 8¾ ins.	12 ft. 0 in.
Lower floor — north	4	Kinnear bifold.	13 ft. 8¾ ins.	12 ft. 0 in.
Lower floor — east	4	Kinnear bifold.	16 ft. 1½ ins.	12 ft. 0 in.
Lower floor — west	4	Kinnear bifold.	16 ft. 1½ ins.	12 ft. 0 in.

Wharf Shed:

Lower floor — south	76	Ogden bifold.	18 ft. 0 in.	22 ft. 0 in.
Lower floor — north	71	Ogden bifold.	18 ft. 0 in.	16 ft. 0 in.
Lower floor — east	3	Ogden bifold.	18 ft. 0 in.	16 ft. 0 in.
Lower floor — west	3	Ogden bifold.	18 ft. 0 in.	16 ft. 0 in.
Upper floor — south	76	Ogden bifold.	18 ft. 0 in.	16 ft. 0 in.

Pier Sheds:

Lower floor — south wharf	39	Ogden bifold.	18 ft. 0 in.	22 ft. 0 in.
Lower floor — north wharf	39	Ogden bifold.	18 ft. 0 in.	22 ft. 0 in.
Lower floor — east wharf	4	Ogden bifold.	18 ft. 0 in.	22 ft. 0 in.
Lower floor — west wharf	4	Ogden bifold.	18 ft. 0 in.	22 ft. 0 in.
Second floor — south wharf	16	Ogden bifold.	18 ft. 0 in.	12 ft. 0 in.
Second floor — north wharf	16	Ogden bifold.	18 ft. 0 in.	12 ft. 0 in.
Third floor — south wharf	16	Ogden bifold.	18 ft. 0 in.	12 ft. 0 in.
Third floor — north wharf	16	Ogden bifold.	18 ft. 0 in.	12 ft. 0 in.
Lower floor — north track	36	Ogden vertical lift.	18 ft. 0 in.	11 ft. 0 in.
Lower floor — south track	36	Ogden vertical lift.	18 ft. 0 in.	11 ft. 0 in.
Lower floor — north ramp	8	Ogden vertical lift.	10 ft. 0 in.	11 ft. 0 in.
Lower floor — south ramp	8	Ogden vertical lift.	10 ft. 0 in.	11 ft. 0 in.

Allowable Loads. —

Storehouse and Pier Shed.................500 lbs. per sq. ft. on lower floor.
Storehouse and Pier Shed.................300 lbs. per sq. ft. on other floors.
Wharf Shed.............................600 lbs. per sq. ft. on lower floor.
Wharf Shed.............................400 lbs. per sq. ft. on upper floor.
Wharf — Pier Shed......................500 lbs. per sq. ft.
Wharf — elsewhere......................600 lbs. per sq. ft.
Provisions are also made on the wharves for cranes and heavy locomotives.

Provisions for Master Keys. —

1. A grand master key for every lock in the project.

2. An electric master key which allows passage to any electrical apparatus in any building.

3. A sub-master key for each building, opening every lock in that building.

4. Sub-master keys for special sections of buildings.

5. Individual keys for each lock.

Open Storage Space.—Westerly of Administration Building — 229 000 sq. ft. gross served by 4 200 lin. ft. of standard-gage railroad track in several lines.

Open wharf west of Wharf Shed — 129 600 sq. ft. gross, served by crane track and two standard-gage railroad tracks throughout its length of 1 020 ft.

Open wharf between Wharf Shed and Pier Shed — 39 000 sq. ft. gross, served by two standard-gage railroad tracks throughout its length of 542 ft.

Open wharf between Pier Shed and Boiler House — 2 640 sq. ft. gross, served by one standard-gage track throughout its length of 63 ft.

Wharf. — A continuous wharf with concrete deck surrounds the site. This wharf will provide 4 150 ft. of berthing space on the southerly side; 950 ft. on the northerly side, and 300 ft. on the easterly end, giving a total length of over one mile. The wharf adjoining the Wharf Shed is 35 ft. in width and contains two railroad tracks and one crane rail. The open wharf at the westerly end of the property is 120 ft. in width and contains a double-track railway line and crane rails. The Pier Shed side wharves each have a net width of 28 ft. and provide for one railroad track on north and on south sides of buildings; the wharf at the east end of the Pier Shed is 25 ft. in width.

Berthing Space. — The accommodation for berthing ships is as follows:

Location.	Length of Wharf in Feet.	No. of Ships.	Approx. Length of Ships.*
West of Wharf Shed....................	1 020	2	300 to 400
Opposite Wharf Shed..................	1 638	3	400 to 500
Between Wharf Shed and Pier Shed......	542	1	400 to 450
Opposite Pier Shed, south side...........	949	2	350 to 400
Opposite Pier Shed, north side...........	1 014	2	350 to 400
† At end of Pier Shed..................	300	1	Small ship.
Total..........................		11	

* The ships under construction by the Emergency Fleet Corporation vary from 380 to 435 ft. in length.

† Emergency use only.

Depth of Channel. — The Reserved Channel on the southerly side of the property, the channel on the northerly side of the property, and the flats easterly of the Pier Shed as far as the main ship channel will be dredged to 30 ft. at M.L.W. Adjoining the Wharf Shed and the Pier Sheds, berthing space having 35 ft. depth is to be provided, thus furnishing opportunity for ships of not more than 32 ft. draft to berth at half tide. Depth of main ship channel from which Reserved Channel leads is 35 ft. at M.L.W.

Disposal of Dredged Material. — Most of the dredged material is rehandled by an hydraulic suction dredge and placed back of a new bulkhead built by the Commonwealth south of the Reserved Channel.

Railroads. — In connection with the plant, a supporting railroad yard with a maximum capacity of 800 cars, exclusive of ladder and running tracks, has been built between Summer Street and the old railroad yard serving Commonwealth Pier. After classification in this yard, cars may be taken to the proper section of the Storehouse by the three tracks on the northerly side of the property, to the Pier Shed by the same tracks or by the two tracks on Terminal Street, to the Wharf Shed by the two tracks on Terminal Street, and directly to the ship side by tracks on the wharves. The tracks in the open space westerly of the Administration Building are for open storage purposes.

Operation. — The Storehouse is to serve as a storage reservoir for freight, thus preventing delays in overseas shipment due to breakdowns in railroad facilities. The Wharf Shed is to be used for the assembling and short-time storage of freight which may be brought in directly either by rail or motor truck, or more commonly from the Storehouse by trailer trucks drawn by electric tractors. It is expected that overseas army supplies will be assembled in the second story of the Wharf Shed shortly before the arrival of a given ship. The ship will then be brought alongside the proper section of the wharf and loaded quickly from the assembled supplies. The Pier Shed is intended for the use of the Navy in equipping ships with supplies, the two upper floors being suitable for storage and the lower floor for transfer or storage.

Elevators. — All elevators are electrically operated. The Storehouse freight elevators are of the automatic, self-leveling type, being equipped with micro-leveling devices, a type of elevator not previously installed in Boston. These elevators level automatically and exactly at any floor. There are twenty-four in all in the Storehouse, four in each section, each of 10 000 lbs. capacity, with platforms 9 ft. 4 ins. by 17 ft. 6 ins. These elevators are of sufficient size to hold four trailer trucks. They may be operated by an operator on the car, but when plant is in full operation the elevators in each section are operated by a dispatcher on the third floor of the section, who will have telephone connections to each floor and to the elevator. The Elevator Supplies Company type of interlocking doors opening automatically when the elevator reaches its proper floor are being installed. Six passenger elevators, each 5 ft. 2 ins. by 7 ft. 0 in. are provided in the Storehouse — one in each section. These elevators have a capacity of 3 000 lbs., a speed of 150 ft. per minute, and are operated by push-button. Five six-ton freight elevators, each 17 ft. 11 ins. by 9 ft. 4 ins., having a speed of 50 ft. per minute with car switch control, are provided in the Wharf Shed. These elevators are furnished with push-button-operated, vertical-lift, double doors of the Peelee type. The Pier Sheds are equipped with 16 six-ton freight elevators, two in each section of each building. These elevators are 19 ft. 2 ins. by 9 ft. 4 ins., have a speed of 50 ft. per minute, and push-button control. They are equipped with double vertical doors of the Peelee type, interlocked with the elevators and operating automatically. The total number of elevators in the project is 51.

Water Supply and Fire Protection. — Water is supplied to the plant by four 16-in. pipe lines, two of which are connected with the Boston low-service and two to the Boston high-service mains, thus providing two practically independent supplies. The pressure in the former system under normal conditions is from 50 to 55 lbs. per sq. in., and in the latter from 90 to 95 lbs. The low-service yard system consists of a single line of 16-in. pipe laid in Dry Dock Avenue, along the north side of the Army Base property. This pipe enters the grounds only at the easterly end near the electric substation. Its function is (*a*) to fur-

nish supply to three 1 000 g.p.m. underwriter's two-stage centrifugal pumps, and (*b*) to supply fire hydrants in Dry Dock Avenue for use of city fire engines. It also provides feed water for the boilers. The high-service yard system consists of a loop of 16-in. pipe line surrounding the Storehouse, with 12-in. branch lines extending at the easterly end to supply the Pier Shed. The northerly side of this loop lies in Dry Dock Avenue and the southerly side in Terminal Street. This system supplies water to sprinklers and standpipe in the various buildings, to fire hydrants throughout the grounds, to wharf hydrants for fire protection and ship supply, and for general purposes through the plant.

All buildings used for storage are equipped with sprinklers as described in the following paragraph. The Storehouse and Pier Shed are provided with standpipes in each stairway, with hose and nozzles attached to outlets at each floor. Chemical fire extinguishers and water pails are provided throughout the plant. The Wharf Shed is provided with coils of fire hose with nozzles, supplied from a pipe system independent of the sprinkler system. In the railroad supporting yard, fire protection is furnished for freight cars by means of hydrants placed at intervals on a 16-in. pipe line connected at each end with the city low-service system.

Heating and Sprinkler System. — Heating of the Storehouse is to a considerable extent by hot water which circulates through the sprinkler pipes, the water being heated in heater rooms in each section by live steam brought from Boiler House through tunnel running longitudinally under Storehouse. Auxiliary steam heat is also supplied to wall radiators and to coils at ceiling of upper floor. The Pier Shed is heated entirely by forced hot water, to be brought by pipe line from Boiler House, and has a dry-pipe sprinkler system. Toilets and offices in Wharf Shed are heated by steam, and the building is sprinklered by the dry pipe system. The Administration Building is to be heated by steam. The Boiler House is equipped with six water tube boilers each of 400 h.p. and has room for two additional boilers. Its capacity may be considerably increased if necessary by forced draft, for which fans are installed. Automatic stokers, weighing scales and steam ash conveyors are also provided.

Electricity. — All electricity is supplied by the near-by Edison Company's L Street Plant across the Reserved Channel. Alternating current is delivered at site at 13 800 volts, and is transformed to 2 300 volts at substation for distribution about plant, and again transformed at various points to 110 volts for lighting and 220 volts for power. Direct current from 230 to 250 volts is supplied for use in cranes and dock winches by two 500 kw. rotary converters located in the substation.

Foundations. — The Storehouse foundations consist of concrete cylinders, one under each column, built in open wells formed by sinking concrete shells, 8 ins. thick and 6 ft. in outside diameter, into the hard clay stratum. The wells were belled out at the bottom, to give sufficient bearing area for the column loads, the diameter of the bells at the bottom varying from 11 ft. to 17 ft. 6 ins., depending upon the load to be carried. The open well is filled with concrete and a concrete cap at the top distributes the load over the shell and core. The Wharf Shed foundations are on wooden piles. The interior foundations for the Pier Shed are Raymond concrete piles; the foundations for the exterior columns on the north and south sides respectively of the two buildings are on reinforced concrete sheet pile bulkheads which also restrain the fill.

Freight-Handling Equipment. — The following equipment has been ordered:

Four electric bridge cranes for the Wharf Shed, spanning both tracks on the wharf. These cranes are of the semi-portal type and have booms capable of being both luffed and turned. These cranes have a capacity of $2\frac{1}{2}$ tons at 44 ft. from the face of the wharf, and can be used to transfer freight between hold of vessel and Wharf Shed balcony, the wharf, or cars on the wharf. These cranes use 230-volt direct current.

Two steam locomotive cranes — 15-ton capacity.

One steam locomotive crane — 18-ton capacity.

One steam locomotive crane — 40-ton capacity.

Twenty-four electric dock winches. These are of the portable type and can be used in connection with cargo hoists or to operate ship's gear. Eight of these are provided with remote control apparatus. These winches have a capacity of

2 500 lbs. at 225 ft. per minute. Frequent outlets are provided along the waterfronts of the wharf and pier sheds for plugging in of connections for these winches. They use 230-volt direct current.

Eighty trailers; Seattle type; size 4 ft. by 8 ft.; capacity 5 000 lbs.

Six hundred trailer trucks. These have castor wheels at one end, and are equipped to be coupled in trains and hauled by tractors. They are 3 ft. by 6 ft. in size and have a capacity of 2 000 lbs.

Forty storage battery trailers. Each of these is capable of hauling a train of eight fully loaded trailer trucks of the above size.

Two hundred hand stevedore two-wheel trucks.

Six vertical tiering machines, electrically operated.

Five piling machines for stacking bags.

Six storehouse scales; three-ton; 72 ins. by 60 ins. platform scales with automatic dials.

One 20-ton, platform truck scale.

Estimated Capacity of Freight-Handling Equipment. — Two hundred carloads — 6 000 tons — can be unloaded from freight cars and put into storage in the Storehouse in a ten-hour day.

One hundred forty carloads — 4 200 tons — can be unloaded from freight cars and put into storage in the Pier Shed in a ten-hour day.

One hundred carloads — 3 000 tons — can be unloaded from freight cars and put into storage in lower story of Wharf Shed in a ten-hour day.

An 8 000-ton vessel can be loaded by means of the bridge cranes in about 55½ hours or, say, 2½ days.

Progress. — Permanent construction began on April 22, when the Storehouse foundations were started. The concrete roof of the last section of the Storehouse was poured on October 3. The last concrete of the Pier Shed structure was poured on November 27, and the last concrete of the Wharf Shed structure on December 6. The first goods were stored in the Storehouse on October 25, and consisted of wool. At date of writing, December 6, four floors of Section A are used as temporary

barracks for about 3,000 sailors, the remainder of that section and the whole of Sections B and C being full of wool and miscellaneous supplies. Engineer's schedule called for completion of project on January 1. Slowing down of work since armistice was signed has delayed progress materially by preventing night work and all overtime, and necessitating that concrete work should be done under freezing conditions.

Determination of Site and General Character of Project. — The site was selected by Major-Gen. George W. Goethals, assistant chief of staff, in charge of storage and traffic, U. S. Army, who also determined that the project should be of permanent character and that the main structure should be suitable for commercial use after the war. The storage capacity required and similar features were determined by Col. F. B. Wells, in charge of storage under General Goethals.

Supervision of Construction. — Construction and disbursements of all funds were under the immediate supervision of Major Charles R. Gow, constructing quartermaster, acting for the Construction Division of the Army — Brig.-Gen. R. C. Marshall, Jr., officer in charge; Col. Frank M. Gunby, and Col. Lincoln Bush in charge of engineering; Col. M. J. Whitson and Col. P. Junkersfeld in charge of construction; Col. J. N. Willcutt in charge of materials; Lt.-Col. R. M. White in charge of terminals; Major C. H. Fisk, supervising constructing quartermaster.

Engineering. — Preliminary and final designs, field engineering and inspection, were by Fay, Spofford & Thorndike, Boston, acting as supervising engineers for War Department, with Hollis French and Allen Hubbard acting as associate engineers for heating and power equipment.

Contractors. — The general contractors were the W. F. Kearns Co., of Boston. The subcontractors for construction were P. McGovern & Co. of New York and Boston, for storehouse foundations; Holbrook, Cabot & Rollins Corp., Boston, for wharf construction; Raymond Concrete Pile Co., New York, for pier shed foundations; and T. Stuart & Son Co., Newton, Mass., for railroad track, grading and underground construction. Other principal contractors were the Bay State Dredging and Contracting Co., General Fire Extinguisher Co., Cleghorn Co.,

Edwin C. Lewis, Inc., John C. Finegan Co., and P. W. Donoghue.

Maximum Number Employed on Construction. — The maximum number employed at any one time on the work in Boston, including army officers, engineers, auditing staff, policemen and firemen, was as follows: Army officers, 12; engineers, 259; government auditing staff, 328; policemen and firemen, 106; contractors' forces, 7 125.

Some Approximate Quantities. —

Concrete	240 000 cu. yds.
Steel reinforcement	13 000 tons
Structural steel	4 300 tons
Timber and lumber for forms	9 532 000 board ft.
Timber and lumber, miscellaneous	7 823 000 board ft.
Timber and lumber, permanent use	3 145 000 board ft.
Timber and lumber, total	20 500 000 board ft.
Cement	445 000 bbls.
Sand	123 000 cu. yds.
Stone and gravel	216 000 cu. yds.
Dredging	3 000 000 cu. yds.
Wood block paving	56 000 sq. yds.
Granite block paving	28 400 sq. yds.
Granolithic paving	197 000 sq. yds.
Bitulithic paving	16 600 sq. yds.
Water mains	22 800 lin. ft.
Sewers and drains	18 000 lin. ft.
Railroad track	18 miles
Wooden piles	30 000
Raymond concrete piles	6 650
Pre-cast sheet piles	1 150
Roofing	6 000 squares
Brick	5 570 000
Metal sash	258 000 sq. ft.
Glazing	260 300 sq. ft.

Cost. — The engineers' estimate of total cost was \$28 000 000, and this amount was appropriated by Congress. It is now anticipated that the cost will be well within this estimate.

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BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PROCEEDINGS

PAPERS IN THIS NUMBER.

Address at the Annual Meeting. Chas. M. Spofford.

"The Disposal of Sewage by Treatment with Acid." Edgar S. Dorr and Robert Spurr Weston.

Memoirs of Deceased Members.

Current Discussion.

Paper.	Authors.	Published.	Discussion Closes.
"The Boston Army Supply Base."	Frederic H. Fay. Charles R. Gow. Wm. H. Kearns. Charles M. Spofford.	March.	May 10.

Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

MINUTES OF THE MEETING.

Boston, March 19, 1919. — The seventy-first annual meeting of the Boston Society of Civil Engineers was held at the Boston City Club, Ashburton Place, Boston, on Wednesday, March 19, 1919.

The thirty-seventh annual dinner which preceded the business meeting was served in the auditorium of the Clubhouse,

at half past one o'clock, the President of the Society, Prof. Charles M. Spofford, presiding.

There were 153 members and guests seated at the tables, and a number of members who were not able to be present at the dinner joined the party before the after-dinner discussion began.

The discussion was opened by the principal guest of the Society, Gen. R. C. Marshall, Jr., chief of Construction Division, United States Army, with a most interesting and carefully prepared paper on "Cost-Plus Contracts," as carried out by the Construction Division in Government war construction work. He was followed by Col. Frank M. Gunby, in charge of Engineering Branch of Construction Division, and a member of the Society, who with the aid of lantern slides described some of the cantonment work of the division, and gave some idea of the diversified character of the problems and construction work with which it had to deal.

Past President Charles R. Gow, the next speaker, took up especially the cost-plus form of contract as applied to the construction of the Boston Army Supply Base at South Boston. Admiral Homer R. Stanford, civil engineer, United States Navy, a guest of the Society, described briefly some of the construction work done by the Navy Department during the war.

Mr. William F. Kearns, president of the W. F. Kearns Company, the general contractors for the Boston Army Supply Base, spoke of that work from the contractor's point of view, and Past President Charles T. Main discussed briefly the merits of the cost-plus form of contract and those of the lump-sum form.

On motion of Past President Fay, a unanimous vote of thanks was extended to General Marshall and Admiral Stanford for their interesting and instructive contributions to the discussion. Mr. Fay regretted that he could not include the others who had taken part in the discussion in the vote of thanks, because it was an unwritten law that members of the Society should not receive such a vote.

At 5.10 o'clock the business meeting was called to order by President Spofford, in the large banquet room on the ninth floor of the Clubhouse. There were about 80 members present.

The record of the February meeting of the Society was read and accepted.

The Secretary reported for the Board of Government that it had elected this afternoon to membership in the Society, Mr. Clarence Reeds in the grade of Member and Messrs. Arthur D. Dickson and Patrick McGovern in the grade of Associate. He also reported that Mr. Herbert A. Wilson, a former member of the Society who resigned, had been reinstated to membership.

The Secretary presented the memoir of Charles H. Dodd, prepared by a committee consisting of Edgar S. Dorr and Richard J. McNulty, and by vote it was accepted and ordered printed in the JOURNAL.

The annual reports being in order, the Secretary read the report of the Board of Government, and by vote it was accepted and placed on file.

The report of the Treasurer was read by that official, and by vote it was accepted and placed on file.

The Secretary read his report and that of the Committee on the Library, and by vote each was accepted and placed on file.

In the absence of the chairman of the Committee on Social Activities, the Secretary read the report of that committee, and by vote it was accepted and placed on file.

Past President Hale presented and read the report of the Committee on Run-Off Available for Water-Power Purposes, and by vote it was accepted and the committee continued.

By vote, the reappointment of the other committees of the Society was referred to the Board of Government with full powers.

The tellers of election, Messrs. N. S. Brock and H. B. Wood, submitted the result of the letter ballot for officers of the Society, and in accordance with their report the President announced that the following officers had been elected:

President — Leonard Metcalf.
Vice-President (for two years) — Robert Spurr Weston.
Secretary — S. Everett Tinkham.
Treasurer — Frank O. Whitney.

Directors (for two years) — Sturgis H. Thorndike and Arthur S. Tuttle.

Members of Nominating Committee (to serve two years) — David A. Ambrose, Harold K. Barrows and Frank A. Marston.

The President then, with appropriate words, presented the Desmond FitzGerald Medal for the best paper read before the Society, to Mr. Stephen DeM. Gage for his paper entitled, "Sanitary Control of Swimming Pools." Mr. Gage on receiving the medal expressed his deep appreciation of and sincere thanks for the honor thus accorded him.

On motion of Mr. C. W. Sherman, the following vote was unanimously adopted:

Voted: That the dues of all members in the military or naval service of the United States or its allies be abated on request for the proportional part of the year 1919–20 that they remain in the service; and that a sum not exceeding five hundred dollars be appropriated from the income of the Permanent Fund to reimburse the Current Fund of the Society.

The retiring President, Charles M. Spofford, then delivered the annual address of the president, which will be printed in the April number of the JOURNAL.

The President then introduced the President-elect, Mr. Leonard Metcalf, who expressed his appreciation of the confidence accorded him by his election and his sincere thanks for the honor.

At 6.20 o'clock the meeting adjourned to participate in the annual smoker which was held in the auditorium of the club.

The program was similar to that of former years. The members found light refreshments awaiting them as they entered the auditorium, and an abundant supply of pipes and tobacco was at hand. Music was furnished throughout the evening by an orchestra of six pieces, and as usual the special songs of the Society were sung, as well as many of the popular songs of the day, under the leadership of Mr. Charles R. Berry, of the committee of arrangements. The entertainment provided was somewhat of an innovation, consisting of readings and recitations by Mr. LaRue Vredenburgh, acrobatic stunts by a Japa-

nese student from the Massachusetts Institute of Technology, and an athletic exhibition, which took the form of a wrestling match, by two students from the same institution.

The informal reception to the new officers and to those members who had joined the Society during the year, a feature inaugurated last year, was repeated.

The attendance at the smoker was 200 and the attendance of members and guests at the several functions was 275.

S. E. Tinkham, *Secretary.*

Annual Meeting of the Sanitary Section.

Boston, Mass., March 5, 1919. — The annual meeting of the Sanitary Section of the Boston Society of Civil Engineers was held this evening at the Boston Engineers' Club.

The meeting was called to order at eight o'clock by the Vice-Chairman, Mr. E. S. Dorr.

The minutes of the last meeting (held December 4, 1918) were accepted, without reading.

The annual report of the Executive Committee was read by the Clerk, and it was voted that it be accepted and placed on file.

The report of the Nominating Committee was read by the chairman of that committee, submitting the following nominations for officers, for the ensuing year:

For Chairman — Edgar S. Dorr.
For Vice-Chairman — Henry A. Varney.
For Clerk — John P. Wentworth.

For additional members of the Executive Committee:

George E. Russell.
Henry T. Stiff.
George A. Sampson.

There were no other nominations.

It was voted that the Clerk be instructed to cast one ballot for the officers as nominated, and they were declared elected for the ensuing year.

No other committee reports were submitted.

After the business meeting, Lieut.-Col. George A. Johnson, of the Maintenance and Repair Branch of the Construction Division of the United States Army, gave an exceedingly interesting description of the Operation and Maintenance of the Utilities at Army Camps and Cantonments.

Major Richard Messer described, in detail, the sewage-disposal system used in the cantonments.

A stenographer's record of the meeting was made, which will be printed in the Society JOURNAL.

Forty-three members and guests were present.

The meeting adjourned at 10.15 P.M.

HENRY A. VARNEY, *Clerk.*

Previous to the meeting, a dinner was given in Colonel Johnson's honor, in the club dining room. Forty-one members and guests were present.

ANNUAL REPORTS.

REPORT OF THE BOARD OF GOVERNMENT FOR THE YEAR 1918–1919.

BOSTON, MASS., March 19, 1919.

To the Boston Society of Civil Engineers :

Pursuant to the requirements of the Constitution, the Board of Government presents its report for the year ending March 19, 1919.

The total membership of the Society a year ago was 917, of whom 813 were members, 64 juniors, 8 honorary members, 26 associates and 6 were members of the Sanitary Section only.

During the year 23 members have resigned, 20 have forfeited membership for non-payment of dues, the membership of 5 juniors has ceased because of age limit, and 15 have died, making total deductions 63.

Thirty-four new members have been added during the year, of whom 7 are former members reinstated; and 4 juniors have been transferred to the grade of member. Three applicants who have been elected have not completed their membership.

The present membership of the Society consists of 8 honorary members, 791 members, 57 juniors, 26 associates and 6 who are members of the Sanitary Section only, making total membership 888.

The loss by death during the year has been 15. The record is as follows:

Frank S. Hanf, died April 28, 1918.
Howard L. Coburn, died June 19, 1918.
Edward A. Buss, died August 18, 1918.
George M. Stevens, died September 19, 1918.
Leslie P. Reed, died September 26, 1918.
James Hayes, Jr., died September 26, 1918.
George R. Burnes, died October 3, 1918.
Harrie L. Whitney, died October 14, 1918.
Charles H. Dodd, died October 27, 1918.
Rufus M. Whittet, died December 15, 1918.
Charles C. Dotten, died December 28, 1918.
Frederick Brooks, died January 10, 1919.
Fred E. Sauer, Jr., died January 15, 1919.
Gilbert Hodges, died February 13, 1919; and
John S. Humphrey, died February 15, 1919.

Two of these, Frank S. Hanf and Leslie P. Reed, died in the war service.

Under authority of By-Law 8, the Board of Government has remitted the dues of 5 members.

Under a vote of the Society passed at the annual meeting last year, the dues of 109 members have been abated on account of war service, and under the same vote the sum of $782 has been transferred from the income of the Permanent Fund to the Current Fund, to make good the loss in the yearly income of the Society.

Only nine regular meetings have been held during the year. The October meeting was omitted in compliance with the request of the Health Department of Boston, that public meetings be given up during the influenza epidemic.

The average attendance at these meetings was 125, the largest being 260 and the smallest 25.

The following papers and addresses have been given:

March 20, 1918. — Address of the retiring President, George C. Whipple, "The Engineer in the New Democracy." Mr. Robert Ridgway of New York, "Some Features of the New York City Rapid Transit System" (illustrated).

April 17, 1918. — Commander H. R. Stanford, U. S. N., "The Pearl Harbor Dry Dock, Hawaii" (illustrated).

May 15, 1918. — Stoughton Bell, Esq., "Cambridge, Mass., System of Real Estate Assessment" (illustrated).

June 19, 1918. — Major Kenneth D. Marlatt, of the Fourth Canadian Mounted Rifles, "War Condition in France."

September 25, 1918. — Clarence T. Fernald and John C. Moses, "Notes on the Construction of Mystic River Bridge, Boston" (illustrated).

November 20, 1918. — Mr. William A. Donnelly, of New York, "Pontoon Floating Dry Docks, their Construction and Use" (illustrated).

December 18, 1918. — A series of papers on the Boston Army Supply Base by Frederic H. Fay, Charles R. Gow, William F. Kearns and Charles M. Spofford (illustrated).

January 22, 1919. — Edgar S. Dorr and Robert Spurr Weston, "The Disposal of Sewage with Acid Treatment" (illustrated).

February 19, 1919. — Mr. Isaac W. Litchfield, on "The U. S. Employment Service, Department of Labor." George F. Swain, "The Engineering Conditions and Problems in France."

The Sanitary Section has held four meetings and two excursions during the year. The following papers have been presented at the meetings of the Section:

March 6, 1918. — Charles H. Parker, "Economy in the Use of Fuel in Power Stations."

May 1, 1918. — W. W. Peters, of Shanghai, China, illustrated lecture on "Health Education in China."

November 15, 1918. — Lieutenant-Colonel Brooks, Major Harrington and Lieutenant Mathes, "Spanish Influenza, Its Cause and Treatment."

December 4, 1918. — W. L. Stevenson, "Sanitation of the Emergency Shipyards."

The excursions were to L Street Power Plant of the Edison Electric Illuminating Company, on March 6, 1918, and to the Worcester Sewage Purification Works on June 5, 1918.

The amount reported last year as contributed to the fund for the purchase of equipment for the 101st Regiment of the U. S. Engineers, in addition to that previously turned in, has been paid in to the regimental fund during the year, making the total amount contributed, $2 226.58.

In May last a request was received for a contribution to the athletic fund of the 602d Regiment of U. S. Engineers, and in response the sum of $585 was raised and turned over to the regiment before it left for France.

The number of stars on the war-service banner hung in the Society rooms has been increased to 127, which represents, so far as information has been received, the number of members of the Society who have entered the war service of their country. Three of these stars are in gilt, designating those of our members who have lost their lives in response to their country's call.

The committee on matters of interest to engineers coming before the Massachusetts legislature has been continued during the year.

At the May and June meetings of 1917, the sum of $500 was appropriated from the income of the Permanent Fund for the improvement and furnishing of the Society rooms; the total amount expended, last year and this year, is $475.08.

The report of the Editor of the Journal for the calendar year 1918 shows that a total of 735 pages were printed in the ten issues, at a cost of $2 367.75, or $3.22 per page, as against $1 997.44, or $2.54 per page, in 1917.

At the last annual meeting it was voted unanimously to abate the dues of all members for the year 1918–19 who were in the military or naval service of the United States or its allies and to appropriate from the income of the Permanent Fund a sum sufficient to reimburse the Current Fund for the resulting loss.

There has been added to the Permanent Fund of the Society, notwithstanding the amount appropriated for the payment of dues of war members, the sum of $1 779.59. The present value of this fund is $43 467.51, and, with the Edward K. Turner Fund amounting to $1 063.22, makes the total of the permanent funds of the Society $44 530.73.

In accordance with the recommendation of the committee appointed to consider the award of the Desmond FitzGerald medal for the best paper by a member of the Society published for the year ending September, 1918, the Board awards that medal to Stephen DeM. Gage, for his paper entitled "The Sanitary Control of Swimming Pools."

For the Board of Government,

CHARLES M. SPOFFORD, *President.*

REPORT OF THE TREASURER.

BOSTON, March 1, 1919.

To the Boston Society of Civil Engineers :

Your Treasurer presents the following report for the year ending March 1, 1919:

Detailed data are contained in the appended tabular statements; Table 1 gives the receipts and expenditures for the year; Table 2, comparative balance sheets; Table 3, investment of the permanent funds.

The revenue applicable to current expenses has been $8 372.88, being $585.52 less than for the preceding year. The current expenses were $8 641.68. The amount of cash on hand is $109.04.

The expense of the JOURNAL has been more than the previous year by $94.40, and the income from advertisements has been $145.77 less than for the preceding year.

There has been an increase in the Permanent Fund of $1 779.59 after transferring from the income $782 for dues of members in the war.

There has been $188 invested in six per cent bonds of the American Telephone and Telegraph Company.

Respectfully submitted,

FRANK O. WHITNEY, *Treasurer.*

TABLE 1. — RECEIPTS AND EXPENDITURES.

CURRENT FUND.

Receipts.

Balance from March, 1918	$377.84
Members' dues	6 363.74
Members' dues paid from income of Permanent Fund	782.00
Advertisements	1 125.50
Sales of JOURNALS	86.60
Library fines	5.36
Interest on bank balances	9.68
	$8 750.72

Expenditures.

Journal		$3 531.32
Printing, stationery, postage and library supplies (net)		507.08
Rent (net)		1 757.08
Light		58.21
Salaries (except editor)		2 093.00
Reporting		108.50
Stereopticon		22.55
Books		10.90
Binding		93.70
Periodicals		92.61
Incidentals		106.90
Insurance		37.66
Annual meeting and dinner		168.02
Sanitary Section, reporting	$10.00	
Stereopticon	9.00	
Incidentals	35.15	54.15
Cash on hand		109.04
		$8 750.72

PERMANENT FUND.

Receipts.

Entrance fees	$260.00
Contribution	100.00
Interest	1 827.87
Returned from Furnishing Fund	24.92
	$2 212.79

Expenditures.

Deficit, March 1, 1918	$34.18
Coöperative bank dues	900.00
Am. Tel. & Tel. Co. bonds purchased	188.00
Transferred to members' dues	782.00
Cash on hand, March 1, 1919	308.61
	$2 212.79

E. K. TURNER LIBRARY FUND.

Cash on hand March, 1918	$29.37
Interest on bond	50.00
	$79.37
Books purchased	$9.90
Cash on hand March, 1919	69.47
	$79.37
1 Bond Am. Tel. & Tel. Co., book value	$993.75
Cash	69.47
Total value of fund	$1 063.22

FURNISHING APPROPRIATION.

Cash, March, 1918	$105.92
Expended	$81.00
Returned to Permanent Fund	24.92
	$105.92

TABLE 2. — COMPARATIVE BALANCE SHEETS.

Assets.	March 1, 1916.	March 1, 1917.	March 1, 1918.	March 1, 1919.
Cash	$3 163.37	$1 443.47	$478.95	$487.12
Bonds and notes	30 366.25	33 318.75	34 835.00	35 023.00
Stock	1 950.00	1 950.00	1 950.00	1 950.00
Coöperative banks	4 190.96	4 747.15	5 930.85	7 179.65
Library	7 500.00	7 500.00	7 500.00	7 500.00
Furniture	2 405.11	2 405.11	2 405.11	2 405.11
	$49 575.69	$51 364.48	$53 099.91	$54 544.88
Liabilities.				
Permanent Fund	$37 475.69	$39 888.17	$41 687.92	$43 467.51
E. K. Turner Fund	1 000.00	997.87	1 023.12	1 063.22
Unexpended appropriations	....	....	105.92	....
Current funds	1 194.89	573.33	377.84	109.04
Surplus	9 905.11	9 905.11	9 905.11	9 905.11
	$49 575.69	$51 364.48	$53 099.91	$54 544.88

TABLE 3. — INVESTMENT OF THE PERMANENT FUND, MARCH 1, 1919.

Bonds.	Par Value.	Actual Cost.	Value as Carried on Books.
American Tel. & Tel. Co. Col. Tr. 4%, 1929	$3 000.00	$2 328.75	$2 737.50
Union Elec. Light & Power Co. 5%, 1932	2 000.00	2 050.00	2 050.00
Blackstone Valley Gas & Elec. Co. 5%, 1939	2 000.00	1 995.00	1 995.00
Dayton Gas Co. 5%, 1930	2 000.00	2 000.00	2 000.00
Milford & Uxbridge St. Ry. 7%, 1923	3 000.00	2 942.50	2 942.50
Railway & Light Securities Co. 5%, 1939	3 000.00	3 000.00	3 000.00
Superior Light & Power Co. 4%, 1931	4 000.00	3 347.50	3 347.50
Wheeling Electric Co. 5%, 1941	4 000.00	3 845.00	3 845.00
Economy Light & Power Co. 5%, 1956	1 000.00	990.00	990.00
Tampa Electric Co. 5%, 1933	2 000.00	2 000.00	2 000.00
Galveston Houston Elec. Ry. Co. 5%, 1954	2 000.00	1 940.00	1 940.00
Northern Texas Elec. Co. 5%, 1940	2 000.00	1 932.50	1 932.50
Chicago & Northwestern Ry. 5%, 1987	1 000.00	1 102.50	1 102.50
Vermont Power & Mfg. Co. 5%, 1928	1 000.00	965.00	965.00
Am. Tel. & Tel. Co. 5%, 1946	1 000.00	993.75	993.75
United States Liberty Loan 3½%, 1947	2 000.00	2 000.00	2 000.00
American Tel. & Tel. Co. 6%, 1925	200.00	188.00	188.00
	$35 200.00	$33 620.50	$34 029.25

Stock.

15 shares Am. Tel. & Tel. Co.	1 500.00	1 950.00	1 950.00
Total Securities	$36 700.00	$35 570.50	$35 979.25

Coöperative Banks.

25 shares Merchants Coöperative Bank, including interest to March	$2 293.75
25 shares Volunteer Coöperative Bank, including interest to January	2 581.70
25 shares Watertown Coöperative Bank, including interest to March	2 304.20
	$7 179.65
Total value of invested funds	$43 158.90
Cash on hand	308.61
Total value of Permanent Fund	$43 467.51

E. K. Turner Fund.	Par Value.	Actual Cost.		
Am. Tel. & Tel. C. 5%, 1946	$1 000.00	$993.75	$993.75	
Cash on hand			69.47	
				1 063.22
				$44 530.73

We have examined the above report and found it correct.

JOHN L. HOWARD,
EDWIN H. ROGERS,
Auditing Committee of Directors of the Boston Society of Civil Engineers.

REPORT OF THE SECRETARY, 1918–19.

BOSTON, March 19,1919.

S. EVERETT TINKHAM, Secretary, *in account with the* BOSTON SOCIETY OF CIVIL ENGINEERS.

For cash received during the year ending March 19, 1919, as follows:

From entrance fees, new members and transfers:

21 members and associates	at $10 =	$210.00	
6 juniors	at 5 =	30.00	
4 juniors transferred to members	at 5 =	20.00	
Total from entrance fees			$260.00

From annual dues for 1918–19, including dues from new members	$6 257.74	
From back dues	44.00	
From dues for 1919–20	62.00	
Total from dues		6 363.74
From rents		1 272.92
From advertisements		1 125.50
From sale of JOURNALS, reprints and cuts		86.60
From library fines		5.36
From contribution to building fund		100.00
Total		$9 214.12

The above amount has been paid to the Treasurer, whose receipts the Secretary holds.

We have examined the above report and found it correct.

JOHN L. HOWARD,
EDWIN H. ROGERS,
Auditing Committee of Directors of the Boston Society of Civil Engineers.

REPORT OF LIBRARY COMMITTEE, 1918–19.

BOSTON, MASS., March 19, 1919.

To the Boston Society of Civil Engineers :

The Library Committee submits the following report for the year 1918–19.

Since the last report, 114 volumes bound in cloth and 403 bound in paper have been added to the library, making a total of 517 accessions.

There are now 9 524 cloth-bound volumes in the library, and those bound in paper number about 2 700.

During the year 283 books have been loaned to members — a slight increase over last year — and fines to the amount of $5.36 have been collected.

Less binding has been done this year than during any recent year, chiefly on account of the increased difficulty — due to war conditions — in maintaining complete files of periodicals and reports, and the delay of publishers, not only in getting out the necessary title-pages and indexes, but also in mailing them after publication. A number of publishers who formerly sent title-pages and indexes to all subscribers have now apparently adopted the policy of sending them only on request.

The decrease in the amount of binding done is of course largely responsible for the comparatively small number of accessions this year, although this may also be accounted for in part by the fact that fewer reports of engineering interest have been issued by government departments and private concerns than in previous years. A tendency toward an increased output both

in reports and engineering text-books may be already noted, however, since the signing of the armistice, and another year will probably see matters well on their way toward normal.

The number of subscriptions to periodicals has increased materially, and the exchange list of the Society's JOURNAL has dwindled proportionately, as a result of the ruling of the War Industries Board in regard to free and exchange lists. Although this ruling provided that publishers might still retain upon their free lists libraries that agreed to bind their publications for permanent keeping, comparatively few were willing to make this exception, the majority preferring to avail themselves of the opportunity to abolish their free lists.

Twelve new books on engineering subjects have been added to Section 10, nine by purchase. Three of the remaining four, — "Concrete Engineers' Handbook," by Hool and Johnson; "American Engineers behind the Battle Lines in France," by R. K. Tomlin, Jr.; and "Sewage Disposal," second edition, by Kinnicutt, Winslow and Pratt, were donated by their respective publishers for review, and a copy of "Plumbing and Household Sanitation," by J. Pickering Putnam, was the gift of Mrs. Putnam.

A number of contributions have been received from Mr. Desmond FitzGerald and Mr. Howard A. Carson.

The Catalogue Equipment and Supply Company have continued their good work in keeping up to date the collection of trade catalogues known as "Catalogue Studies," and have ordered a new section for the case containing this collection, to accommodate its rapid growth. Pocket indexes to "Catalogue Studies" will be furnished to members on request.

The card catalogue of the library has outgrown its quarters in the old six-drawer cabinet, and a new cabinet, consisting of base, top and nine-drawer unit, to which sections may be added at any time, has been purchased. A new sign has also been provided for the Clemens Herschel Library.

Respectfully submitted,

S. EVERETT TINKHAM,
FREDERIC I. WINSLOW,
Library Committee.

REPORT OF THE EXECUTIVE COMMITTEE OF THE SANITARY SECTION.

BOSTON, MASS., March 5, 1919.

To the Boston Society of Civil Engineers:

The Sanitary Section has held four meetings and two excursions, during the year, as follows:

March 6, 1918. — Excursion to L Street power plant of the Edison Electric Illuminating Company. Attended by thirty members.

March 6. — Annual meeting. After the annual business was disposed of, a paper on "Economy in the Use of Fuel in Power Stations" was read by Charles H. Parker, superintendent of the Generating Department of the Edison Company of Boston. Fifty-three members and guests were present.

May 1. — Special meeting. Illustrated lecture on "Health Education in China," by W. W. Peters, of Shanghai, China. Forty-one present.

June 5. — Excursion to Worcester Sewage Purification Works. Attended by forty-three members and guests.

November 15. — Postponed regular meeting. Subject: "Spanish Influenza, Its Cause and Treatment," by Lieutenant-Colonel Brooks, Major Harrington and Lieutenant Mathes. Twenty-five members and guests were present.

December 4. — Regular meeting. Subject: "Sanitation of the Emergency Shipyards," by W. L. Stevenson, sanitary engineer. Twenty-nine members and guests were present.

Previous to the meeting of December 4, twenty-three members and guests dined at the Engineers' Club.

A small attendance to the above meetings was due to the fact that a large proportion of our membership was absent on war work. Other meetings were arranged for, during the fall, but, on account of the influenza epidemic, could not be held.

No January meeting was held, owing to the fact that the paper by Mr. Dorr and Mr. Weston, although on a strictly sanitary engineering subject, was read before the main Society. All the papers presented at the above meetings have been published in the Society Journal.

None of the committees have been able to do any work on the subjects assigned to them, on account of their being engaged in war matters.

Two new members were enrolled during the year, so that the total membership is now 174.

Respectfully submitted,

Executive Committee,
Henry A. Varney, *Clerk.*

Report of the Committee on Social Activities.

Boston, Mass., March 11, 1919.

To the Boston Society of Civil Engineers :

There have been two excursions during the past year included in the activities of the Society, and this committee has assisted in the details necessary for the success of these excursions.

The field day and excursion of the New England Water Works Association and the Boston Society of Civil Engineers was held at Pemberton, June 19, 1918. Members and guests assembled at Rowes Wharf, where the boat was taken for Pemberton at 10.15. The program included a ball game between the members of the two societies, dinner at Pemberton Inn and an entertainment during the dinner followed by an address by Major Marlatt, of the 4th Canadian Mounted Rifles. The ball game was won by the New England Water Works Association, the score being 7 to 1. There were 114 members and guests at the dinner, many ladies being among the guests.

Through the courtesy of Major Charles R. Gow, constructing quartermaster, U. S. A., and Mr. Frank W. Hodgdon, chief engineer, Waterways and Public Lands Commission, there was an excursion to the United States Army Supply Base and to the Commonwealth Dry Dock, December 18, 1918. The party was conducted by guides through the grounds and buildings of the Army Supply Base and also through the Dry Dock, and had the opportunity to see everything of interest. Through the courtesy of Mr. James W. Rollins, inspection of the work from tug boats was included in the program. Mr. W. F. Kearns, of W. F. Kearns Company, engineers and contractors, associate member of the Society, very generously extended an invitation to the company for refreshments which were served at the conclusion of the excursion. The attendance at this excursion was about 325.

Respectfully submitted,

David A. Ambrose,
Chairman Committee on Social Activities.

Progress Report of Committee on Run-Off.

Boston, March 19, 1919.

To the Boston Society of Civil Engineers :

The Boston Society of Civil Engineers Committee on Run-Off, appointed December 20, 1916, made a report to the Society which was published in the Journal for April, 1918, and a further report which was published in the Journal for November, 1918.

The purpose of the report of November, 1918, was to put into the hands of members of the Society and others interested, for their information, a number of chapters on topics which have already been discussed to some extent by members of the committee; and which, after more thorough discussion, it is proposed to incorporate in the final report of the committee, to be made at a later date.

These chapters are as follows:

Glossary of Terms.
The Use of the Current Meter in Stream Gaging.
0.2 and 0.8 Method of Current-Meter Measurement in Power Canals.
Precipitation, Evaporation and Run-off.
The Effects of Ice on River Discharge.
Methods to be Used in Compilation of Data. Analysis of Run-off Records.

Copies were sent to engineers particularly interested in hydraulic matters, with the following letter:

" *Dear Sir :*

" A Progress Report of the Committee on Run-off of the Boston Society of Civil Engineers is being sent you with the hope that you will find the time and interest to examine it carefully and give the committee the benefit of any suggestions or criticisms you wish to make.

" The purpose of this committee is to collect, compile, analyze and report on the best figures of run-off, in New England, which are available for water-

power purposes. It is the intention of the committee, before reporting any records, to carefully examine both published and unpublished records of stream-flow, and to study these records along the lines indicated in this progress report, and others which will appear later in the JOURNAL.

"Any assistance or contribution either as to the accuracy of New England records or the importance of the methods discussed by the committee will be very much appreciated and of great assistance in making the final report of the committee valuable to engineers and others.

"An early reply is essential to the committee.

"Very truly yours."

Replies have been received from a number of engineers, full of helpful suggestions, which the committee are now discussing. The list of engineers contributing to the discussion is as follows:

Paul L. Bean, chief engineer, Public Utilities Commission, Augusta, Me.
Clinton Bogert, Room 2200, Municipal Building, New York.
C. E. Chandler, Chandler & Palmer, 161 Main Street, Norwich, Conn.
*John R. Freeman, Grosvenor Building, Providence, R. I.
Clemens Herschel, No. 2 Wall Street, New York, N. Y.
Robert E. Horton, construction hydraulic engineer, 57 North Pine Avenue, Albany, N. Y.
Ivan E. Houk, The Miami Conservancy District, Dayton, Ohio.
*Chas. T. Main, engineer, 201 Devonshire Street, Boston, Mass.
*I. W. McConnell, American International Shipbuilding Corporation, Hog Island, Pa.
F. H. Newell, professor of civil engineering, University of Illinois, Urbana, Ill.
C. M. Saville, Board of Water Commissioners, Engineering Department, Hartford, Conn.
Frederic P. Stearns, civil engineer, 1 Ashburton Place, Boston, Mass.
Arthur E. Winslow, professor of civil engineering, Norwich University, Northfield, Vt.
C. O. Wister, 57 North Pine Avenue, Albany, N. Y.

It is recommended that the committee be given time enough by the Society to complete its work and make the final report something of real value to the subject of run-off of streams in New England.

ARTHUR T. SAFFORD, *Chairman*,
CHARLES H. PIERCE, *Secretary*,
HAROLD S. BOARDMAN, *Vice-Chairman*,
A. C. EATON,
X. HENRY GOODNOUGH,
RICHARD A. HALE,
CHARLES W. SHERMAN,
HERBERT A. MOODY,
W. FRANK UHL,
JOSEPH F. WILBER,
DANA M. WOOD,
Committee on Run-Off.

*Acknowledged receipt of letter and report but offered no comments.

Report of the Editor.

To the Board of Government of the Boston Society of Civil Engineers:

Gentlemen, — The Editor submits the following report for the year 1918.

During the year 20 papers and 4 memoirs of deceased members have been published in the Journal. The customary 10 issues of 1 250 copies, each, have been printed. The total number of pages used was 735 and the net cost $2 367.75, or $3.22 per page, a considerable increase over the corresponding cost in 1917.

On account of war conditions the year has been a difficult one in many ways. Engineers have been largely engaged in war-time activities, and have had neither the time nor inclination to prepare papers for publication, with the result that it has often been necessary to assemble material hurriedly and send it to the printer without suitable preparation or editing.

The tremendous pressure under which industries have operated and which can hardly be realized except by those actually engaged in industrial enterprises, has made it, at times, impossible to publish the Journal with promptness, even after the material was in the hands of the printer.

Difficulties commenced with the "heatless Monday" order of the Fuel Administrator, of last January, and constantly increased as the draft and other war work drew increasing numbers of men from the printer's forces.

Financially, the almost universal cutting of advertising appropriations by corporations has resulted in some loss of revenue. It is needless to say that attempts to acquire new advertisements during this period have been most discouraging.

The net loss of advertising space, however, amounting to one page, is less than might have been expected under the circumstances.

It is also encouraging to note that several firms who discontinued their advertisements and who have been interviewed on the matter have expressed their intentions to renew their contracts at an early date.

The appended table gives in detail figures of cost, number of pages printed, etc.

Respectfully submitted,

W. L. Butcher, *Editor*.

Month.	Pages of: Papers.	Pages of: Proc.	Pages of: Index.	Pages of: Adv.	No. of: Inserts.	No. of: Cuts.	Cost of: Papers, Proc. and Index.	Cost of: Cuts.	Cost of: Advts.	Cost of: Reprints.	Cost of: Postage, Wrapping and Mailing.	Cost of: Editing.	Cost of: Incidentals.	Cost of: Copyright.
Jan.	52	9		16½		23	$236.28	$39.84	$21.93	$28.25	$16.68			$10.00
Feb.	52	10		16½		9‡	217.18	8.84	19.65	18.50	15.91			
Mar.	38	11		15½		15‡	186.43	24.75	15.88	15.50	16.26		$1.32	
Apr.	50	32		15⅓		10‡	288.51		18.85	27.75	16.53			
May	36	11		15⅓		10‡	177.04	28.41	15.10	18.20	15.60		0.66	
June	92	9		15¼		23‡	357.46	10.70	15.80	42.50	13.43			
Sept.	46	12		14⅓		3‡	220.56		17.45	21.25	16.46		0.06	
Oct.	20	5		14⅓	4	13	116.86	124.94	16.55	15.00	18.29		43.29†	
Nov.	36	5		14⅓	3	2	179.27	111.13	17.80	25.00	18.70			
Dec.	26	9	10	15½		4	169.99	15.47	21.70	14.75	18.57		0.12	
Total	448	113	10	153+*	7	112	$2 149.58	$364.08	$180.71	$226.70	$166.43	$450.00	$45.45	$10.00

Total gross cost		$3 592.95
Subscriptions	$54.00	
Sale of JOURNALS	31.20	
Sale of reprints	19.50	
Advertisements	1 120.50	
		1 225.20
Net cost		$2 367.75

* 164 pages used, not set solid.
† Includes 10 000 wrappers, $43.00.
‡ Some cuts furnished without expense to the Society.

APPLICATIONS FOR MEMBERSHIP.

[April 15, 1919.]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

CASHMAN, JAMES EUGENE, Burlington, Vt. (Age 43, b. Quincy, Mass.) Graduate of Quincy High School, 1894, and student at Boston Night School of Designing and Drafting. Has had twenty-five years' experience in construction of fortifications, breakwaters, roads and buildings; was for five years general manager and treasurer of Bay State Dredging & Contracting Co., during which time the company was contractor for Bellevue Hill water tower, Metropolitan Park boulevard at Quincy, high-level sewer at Needham, and numerous other jobs of importance, including dredging in connection with Boston Army Supply Base; is now general contractor and engineer and treasurer of Bay State Dredging & Contracting Co.; is member of Vermont Society of Engineers. Refers to C. B. Breed, W. H. Ellis, Jr., T. T. H. Harwood, C. T. Main, F. D. Smith and B. T. Wheeler.

RANKIN, ELMER PAULL, Boston, Mass. (Age 22, b. New Bedford, Mass.) Educated in public schools, at Franklin Union (evening courses, 1915–16), and at Lowell Inst. School for Industrial Foremen, 1916–18. From May, 1914, to November, 1915, draftsman and field inspector with W. S. Johnson, C. E.; from September, 1917, to April, 1918, structural draftsman with Stone & Webster; from April, 1918, to date, structural draftsman and designer with Fay, Spofford & Thorndike. Refers to C. R. Berry, C. A. Farwell, J. S. Lamson and H. C. Thomas.

ROLL OF HONOR.*

ADDITIONS.

DEPUY, CLARENCE S. Captain, Q. M. C., Const'n Div., U.S.A., Room 1-234, Washington, D. C.

REVISIONS.

DURHAM, HENRY WELLES. Major, Engineers, U.S.A., Dept. of Const'n and Forestry, Tours, France, Am. Ex. Force.

ENEBUSKE, CARL C. Master Gunner, office of Chief of Artillery, First Army, Am. Ex. Force, France.

HARRIS, GILBERT M. Private, care Div. Engr. Office, 1st Replacement Depot, St. Aignan-Noyens, Am. Ex. Force, France, A. P. O. 727.

HARTY, JOHN J. Captain, Ordnance Dept., U.S.A., Base Ordnance Depot No. 4, Base Section No. 2, A. P. O. 705, Am. Ex. Force.

HUBBARD, CARL P. Captain, Company C, 11th Engrs. (Ry.), Am. Ex. Force, France.

NEWMAN, ROLF R. Captain, Engineers, U.S.A., The Engineer School, Camp Humphreys, Va.

WORCESTER, ROBERT J. H. 1st Lieutenant, Company E, 117th Engrs., 42d Div., U.S.A., Am. Ex. Force, France.

LIST OF MEMBERS.

ADDITIONS.

REEDS, CLARENCE........................8 Merrimack St., Lowell, Mass.
WILSON, HERBERT A.......................6 Beacon St., Boston, Mass.

CHANGES OF ADDRESS.

BOAS, BENJAMIN......................73 Hancock St., Dorchester, Mass.
BRESTH, ALEXANDER...Care Florida State Board of Health, Jacksonville, Fla.
EICHORN, FREDERICK C. H.............306 South St., Jamaica Plain, Mass.
FAIR, GORDON M.....Engineering School, Harvard Univ., Cambridge, Mass.
FARRELL, FRANCIS B....................86 St. James Ave., Boston, Mass.
GARVEY, JOHN C.,
Care Casper Ranger Const'n Co., 20 Bond St., Holyoke, Mass.
MCCONNELL, IRA W.....................61 Broadway, New York, N. Y.
PHILLIPS, LAURENCE J.........100 Boylston St., Room 1003, Boston, Mass.
TAYLOR, PHILIP W.,
Care Lockwood, Greene & Co., Yorkship Village, Camden, N. J.
WENTWORTH, JOHN P.....................66 Sprague St., Malden, Mass.
WOOD, LEONARD P.....Care Franklin Tr. Co., 46 Wall St., New York, N. Y.
WRIGHT, EDWARD..................Room 141, State House, Boston, Mass.

* Members who are in the service and have not yet reported that fact to the Secretary are earnestly requested to do so, stating branch of service, rank and military address.

RESIGNATIONS.

(In effect March 19, 1919.)

Atwood, Thomas C.	Janes, Charles F.
Bonnet, Frederic, Jr.	Jerrett, Robert.
Brunel, Richard.	Lanza, Gaetano.
French, Herman W.	Moses, Ernest M.
Hakes, Jesse F.	Robinson, Harold L.

EMPLOYMENT BUREAU.

The Board of Government maintains an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society rooms two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

Men Available.

445. Age 47. Graduate of Dartmouth College, degree of B.S. Experience covers five years with Massachusetts Metropolitan Water Board on reservoir construction and seventeen years in responsible charge of important municipal work; recently discharged from U. S. Army, where he held rank of captain, Q.M.C., Construction Division, having been assigned as officer in charge of utilities at U. S. A. general hospital. Would be interested in engineering position dealing with water, sewers, streets or operation and maintenance of utilities. Salary desired, $3 000 per year.

450. Age 31. Graduate of Tufts College, 1911. Has had seven years' experience with manufacturers of electrical machinery and chemical apparatus; experience includes shop practice, testing, production, costs and inspection. Desires position as assistant to executive with manufacturing concern. Salary desired, $1 800 per year.

451. Age 35. Graduate of Copenhagen Univ., Denmark; student for one year at Columbia Univ. evening school and for four and one-half years at Cooper Union evening school, technical and engineering courses; passed examination for junior civil engr., Engineering Dept. at Large, Washington, D. C., 1915, and for expert aid, 1918. Has had wide experience along engineering lines, including two years as architectural draftsman and detailer in woodworking mill; eight and one-half years with engineering department of railroad, as rodman, inspector, chief of party and draftsman on variety of

work; eight months on railroad valuation work; nineteen months as engineer with firm of contractors, Pittsburgh, Pa.; and nine months as draftsman and progress engineer on Boston Army Supply Base. Desires permanent executive position. Minimum salary desired, $2 500 per year.

452. Age 38. Student for three and one-half years at Univ. of Michigan, civil engineering course. Has had seventeen years' experience, chiefly as superintendent or resident engineer on construction work. Desires position as resident engineer on location or construction work. Salary desired, $200 per month.

453. Age 41. Graduate of Mass. Inst. of Technology, degree of S.B. Has had seventeen years' experience in municipal work, especially water works and filtration; was captain with Construction Div., U.S.A., Water and Sewer Section. Desires position as manager or superintendent of water works.

LIBRARY NOTES.

Book Review.

"American Engineers Behind the Battle Lines in France," by Robert K. Tomlin, Jr., war correspondent for the McGraw-Hill Publications. First edition. New York, McGraw-Hill Book Co., Inc. Cloth 9 x 12 in., pp. 91, illustrated. $2.00.

Reviewed by Lewis E. Moore, Major Engrs., U.S.A.

Mr. Tomlin was a war correspondent for the *Engineering News Record* in France. This volume is the collection under one cover of the very interesting articles which he wrote and which were originally published at intervals in the *Engineering News Record*. They give an excellent résumé of the varied activities of the engineers who worked back of the lines in France, and are of considerable historical value as a record of achievement, even though it has been necessary to omit names both of persons and places. It naturally does not cover the activities of the so-called "pioneer" or combat engineer troops. The book is written in popular rather than technical style, and contains much of interest to both the engineer and the layman.

Recent Additions to the Library.

U. S. Government Reports.

Annual Report of Federal Board for Vocational Education for 1918.

Contributions to Economic Geology, 1917: Part II. — Mineral Fuels. David White.

Economic Limits to Domestic Independence in Minerals. George Otis Smith.

Effect of Grazing upon Aspen Reproduction. Arthur W. Sampson.

Estimates of Population of United States, 1910–1917.

Extinguishing and Preventing Oil and Gas Fires. C. P. Bowie.

Fuel Facts. 2d ed. 1918.

Geology of Northeastern Montana. Arthur J. Collier.

Gold, Silver, Copper, Lead and Zinc in Utah in 1916. V. C. Heikes.

Gold, Silver, Copper and Lead in South Dakota and Wyoming in 1917. Charles W. Henderson.

Inflammability of Aluminum Dust. Alan Leighton.

International Control of Minerals. C. K. Leith.

List of Publications of Federal Board for Vocational Education, February, 1919.

Method of Least Squares Applied to Estimating Errors in Coal Analysis. J. D. Davis and J. G. Fairchild.

Methods for Routine Work in Explosives Physical Laboratory of Bureau of Mines. S. P. Howell and J. E. Tiffany.

Mining and Milling of Lead and Zinc Ores in Missouri-Kansas-Oklahoma Zinc District. Clarence A. Wright.

Pulpwood Consumption and Wood-Pulp Production in 1917. Franklin H. Smith.

Private Forestry. Henry S. Graves.

Relation of Dehydration to Agriculture. Maj. S. C. Prescott.

Suggestions for Improved Methods of Mining Coal on Indian Lands in Oklahoma. J. J. Rutledge and Daniel Harrington.

Tin in 1916. Adolph Knopf.

Use of Wood for Fuel. Office of Forest Investigations.

State Reports.

Michigan. Annual Report of State Board of Health for 1917–18.

County Reports.

Essex County, Mass. Engineer's Report for 1918.

City and Town Reports.

Belmont, Mass. Annual Report of Water Commissioners for 1918.

Boston, Mass. Twenty-Fourth and Final Report of Transit Commission, for 1917–18.

Concord, Mass. Annual Report of Road Commissioners for 1918.

Detroit, Mich. Annual Report of Water Commissioners for 1917–18.

Detroit, Mich. Report on Grade Separation in Detroit, 1917–18.

Dover, N. H. Annual Report of Water Commissioners for 1918.

Newton, Mass. Annual Report of City Engineer for 1918.

Newton, Mass. Annual Report of Street Commissioner for 1918.

North Adams, Mass. Annual Reports of Officers for 1918.

Providence, R. I. Annual Report of Water Supply Board for 1918.

Rutland, Vt. Annual Report for 1918.

Miscellaneous.

Building of a Wooden Ship. Charles G. Davis. Edited by Thomas W. Clarke and Frank S. Drown. Gift of T. W. Clarke.

Canada, Department of Mines: Preliminary Report of Mineral Production of Canada during Calendar Year 1918. John McLeish.

Engineering Index Annual for 1918.

Fourth Dimension Simply Explained. Henry P. Manning.

Industries and the State under Socialism. Rome G. Brown.

(The) League of Nations. Woodrow Wilson and others.

(The) Lodge-Lowell Debate. Henry Cabot Lodge and A. Lawrence Lowell.

Plan for Railroad Reorganization. William G. Raymond.

Some Postal Economics. Charles Johnson Post and Jesse H. Neal.

Vacuum Oil Co.: Horizontal Gas Engines (Small and Medium); Horizontal Gas Engines (Large); Vertical Gas Engines; Stationary Steam Engines; Lubrication of Automobile: Part 1, The Engine; Part 2, The Chassis.

Yeomans Brothers Co.: Pumping Machinery.

LIBRARY COMMITTEE.

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BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications

ADDRESS AT THE ANNUAL MEETING.

BY CHARLES M. SPOFFORD, PRESIDENT BOSTON SOCIETY OF CIVIL ENGINEERS.

(March 19, 1919.)

RECONSTRUCTION AND THE ENGINEER.

THE officers' reports just presented show that in spite of war and pestilence our Society has prospered during the past year. At our meetings and for our publications we have received papers illustrating the ever-broadening scope of the engineers' activities. Our membership has decreased but slightly; our current funds have been enough to cover all expenses except the remission of dues for members in service, which has been met by the use of income from the permanent fund; our meetings have been well attended; we have put into operation for the first time the new method of electing officers adopted last year, a method the success of which may be confidently predicted from the high standing, professionally and otherwise, of those elected to office to-day.

Our members have played an important part in winning the war. Some have seen active service overseas; others have been foremost in formulating and executing the great engineering projects carried on by the Construction Division of the Army and by other Government departments, projects which by their magnitude and speed of construction gave overwhelming proof to our enemies that both in organization and deeds the free citizens of this country could accomplish more than the

ponderous German war machine. Some of the war work of our members has already been set forth in our Transactions; it is hoped that during the coming year additional papers may be printed, to the end that our records may present in full the value of the service rendered to the country by our members.

It is not my intention, however, to consider the past; it is the problem of the future which should receive our attention as well as that of all other seriously minded persons. Never before has mankind had the opportunity that now lies before it. Our ancestors established here in America a new nation whose rulers received their authority neither by divine right nor by force of arms but by the free choice of their fellow-citizens, and we look upon it as one of the great forward steps of humanity. The thirteen American colonies had the same language and common aspirations, yet the task of welding them into a nation and keeping that nation intact as it grew was a mighty one. A deadly civil war was necessary to interpret its constitution; participation in the greatest of all wars has not entirely succeeded in fusing its discordant parts into a homogeneous mass.

We of this generation are, however, planning to establish a new world; to organize a federation of nations varying in tradition, in language, in religion; bearing the memories of deadly struggles with one another, of oppression one over the other, but united, we hope, in the determination that their leaders, whether emperors or presidents, shall no longer find it possible by means of secret alliances to force them into unjust wars in order to satisfy a thirst for power.

Whether or not we believe the present draft of a constitution for a league of nations is a proper one and properly preserves the nationality of our country, we all hope and believe that some formula will be found by the congress now meeting in Paris which will hereafter protect all civilized nations from the attack of predatory nations such as Germany.

The success of this new league will depend upon the knitting together of its distant members, both by land and by sea, more closely than ever before. The tendency to Bolshevism must be reduced by the greater development of natural resources; deserts such as Mesopotamia must again be made fertile by irrigation;

the mineral and agricultural wealth of Russia, China and Siberia must be put at the command of the world. All of these problems require the services of the engineer for their solution, and, as in the new federation, the United States, with its great resources affected but little by the war, and now a creditor instead of a debtor nation, will be foremost, so its engineers are sure to be called upon to take a more active part in the development of the world than ever before.

To fill this rôle successfully, the American engineer must, however, show himself to have breadth of view; must not permit himself to be lost in engineering detail; must appreciate more than ever before that it is *the man behind the engineer that counts;* that engineering training is merely a tool which of itself is of little value; that for its efficient use character, judgment, vision, courage, energy, resourcefulness, knowledge of men and ability to carry responsibility are all essential. Lacking these qualities, no engineer will attain leadership in the affairs of the greater world. The engineer who does not possess them naturally, or attain them by experience and study, may achieve some success, but the rewards of leadership will not be his. He will continue to follow others; to be under the control of men with broader views and larger interests; to be a servant instead of a commander.

The technical schools — some of them, at least — recognize that the education of the engineer should, in the future, lay more emphasis on the training of the man along lines which will develop the qualities just enumerated than upon the purely professional studies, and we engineers in practice would do well to impress the same view upon the younger engineers with whom we are associated, to encourage them to familiarize themselves with foreign affairs and with economic and social questions, not to be afraid to search for and accept new opportunities and responsibilities, to the end of self-development and progress.

But what about the more immediate future in our own country? Never before, apparently, has our country stood in greater need of men with engineering training, accustomed to base conclusions upon proven facts, not upon passing emotions; to predict results, not from guesses but from established laws.

The unprecedented financial obligations assumed by the country; the reduction in its man-power by emigration; the higher wages which labor has won, and which, while they will undoubtedly drop, will probably never reach the low figure we were accustomed to before the war, — all demand economies and efficiencies never before required, to secure which trained men, intelligent administrators and planners, will be more needed than ever. Ill-conceived and poorly operated enterprises will have greater difficulties in existing; the engineer will have a greater chance than ever. Moreover, our natural resources will have to be developed; water-power will be utilized as never before; to economize in coal great central power plants will be constructed at the seaboard and at the coal fields; hydraulic-power plants will be linked together; foreign commerce will be carried by American ships, and our ports, rivers and inland waterways will be improved.

In spite of the impending prosperity of the future, the present period of stabilization and readjustment may prove a trying one. What can we as individuals, and as an organization, do to take advantage to the utmost of the public recognition of the importance of engineering made manifest by the war and now reflected by the large influx of students at technical schools? To accomplish this, the individual engineer may well play his part in promoting public and private improvements. It is to him that the expenditure of large sums must be intrusted in case such work is carried out, and he should now display his foresight and skill in planning projects of public benefit in order not only that labor may find employment and be content, but also that public needs may be anticipated and economies thereby secured even at high rates for wages and materials. He should also be willing to serve the public when called upon, in unpaid positions if necessary, in order that public construction projects may receive expert criticism in advance of construction, and public funds be thereby conserved.

For the engineering societies I would suggest two things.

First, the carrying on of a campaign of education in papers and popular magazines in order to inform the public what the engineer's duties are and why he should be employed. The

public — at least the more intelligent public — should be made to realize that the civil engineer is not merely a surveyor; that mechanical engineers are not enginemen; that electrical engineers are not linemen. The cost of such a campaign might be great; its value, I believe, would be greater. Such instances as failures of bridges, dams and molasses tanks should be used to point out the economic loss resulting from the failure of owners to secure the advice of competent engineers upon the design of important structures and of paying them fees commensurate with the skill required.

Secondly, I believe that the societies should urge the regulation of engineers, either by the state or by the engineering societies themselves. In this state, no doctor can practice without registration, nor without holding a diploma from a school authorized by law to grant a medical degree. No lawyer can be admitted to practice at the bar without the sanction of the courts — also a matter of state regulation.

Is it less important for the public welfare that men should be allowed to design and construct structures, on the safety of which sometimes depends the lives not only of individuals but also of whole communities, without proving to a competent board their ability and skill? In my judgment, such regulations would aid the engineering profession as a whole and give it a higher standing in the community, even though it is true that if adopted many now calling themselves engineers might have to content themselves in the future with a less pretentious title until passing the requirements laid down by the board of examiners; this should, however, encourage self-improvement, and thus be a service rather than a detriment to the individual.

In considering in what further manner the engineering societies may improve the standing of their members in the community we must not ignore a recent movement which is sure to have the opposite effect; viz., the establishment of new engineering societies which are affiliating themselves with labor unions. It is said that such organizations have been stimulated by the belief that the older national and local engineering societies — such, for example, as our own society — are controlled by engineers who, for the larger part, are employers and there-

fore not interested in obtaining increased compensation for the younger men. This feeling I believe to be entirely unjustified, and I am sure I speak for the individual members of this Society when I say that we are anxious to raise the scale of compensation for all engineers, both young and old. The method to be adopted is, however, not obvious. The engineering societies were not formed for the mere purpose of raising the compensation of their members, but rather in order that members might benefit by the experience of others as presented in papers, and by acquaintance with one another made through the medium of regular meetings, thereby increasing their ability to serve their clients and the community and thus increasing their value and incidentally their compensation.

On the other hand, a principal object of the labor unions has been to increase wages without increasing the value of the service rendered. It is, however, an interesting fact that the labor unions in Boston are now planning to establish educational courses for their members, thereby adopting to a certain degree the policy of the professional societies.

Is it not possible that the engineering societies might well take action looking towards the setting up of minimum standards of compensation for their members by means of voluntary agreements?

This is a question which I believe should receive the serious consideration of the members of this Society.

And now, in closing, let me express my appreciation of the honor done me by the Society in permitting me to serve as its president during the last year, and to extend to our new President and his associates my heartiest best wishes for a successful year.

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BOSTON SOCIETY OF CIVIL ENGINEERS
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PAPERS AND DISCUSSIONS

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THE DISPOSAL OF SEWAGE BY TREATMENT WITH ACID.

By Edgar S. Dorr* and Robert Spurr Weston,† Members of the Boston Society of Civil Engineers.

(Presented January 22, 1919.)

Introduction.

In the sewage disposal realm, several ideas struggle for mastery: first, that of the economist, now many years old, that the enormous loss of fats and fertilizer caused by the discharge of human wastes into our rivers and oceans should be prevented; second, that of the sanitarian, that human excrement should not endanger human life; third, that of the lover of beauty, that nuisance and unpleasantness should be avoided; fourth, that of the engineer, that the ends of health and beauty should be obtained efficiently and economically; and fifth, that of the citizen, that he should not pay an excessive price for benefits received.

The enormous values of the products wasted with sewage have allured many engineers to attempt to recover them, as the hundreds of descriptions of patents, processes and plants, in the scientific literature of the past twenty-five years, testify.

* Engineer of Sewer Service, Public Works Dept., City Hall, Boston, Mass.
† Of Weston & Sampson, Consulting Engineers, 14 Beacon Street, Boston, Mass.

Note. — Discussion of this paper is invited, to be received by W. L. Butcher, Editor, 715 Tremont Temple, Boston, before June 10, 1919, for publication in a subsequent number of the Journal.

Quite recently Dr. Samuel Rideal* has estimated that, from the camps in England, 40 000 lbs. of fat might be recovered daily, and from the rest of the population, 400 000 lbs. daily. Dr. Rideal also states that the pressed and dried sludge from the Dresden sewage contained 13.4 per cent. of fat, which was extracted by ethylene chloride. It has been reported that during the war many other German cities have used sewage as a source for fats; also that the city of Stockholm, Sweden, has done the same. Although these were war-time measures, the possibility of recovering the 7 300 tons of fats and the 27 000 tons of fertilizer discharged annually with the Moon Island sewage is alluring as a peace-time practice.

What has been the result in normal times of the many attempts to recover valuable products from sewage? The Chinese and others have made use of human excrement for fertilizer, and evidences of the practice are carried away in the nostrils of travelers from the Far East; but so far there are only two methods of disposal for water-borne wastes which have shown a real profit in practice, namely, farming with sewage irrigation in arid districts, and the acid process when applied to wool-scouring waste or to sewage consisting largely of wool-scouring waste, as at Bradford, England. During the war the profits of the Bradford plant were very large.

Sludge Treatment.

While so far the efforts to recover fat and fertilizer from ordinary aqueous sewage have not proved profitable, several noteworthy attempts have been made to recover valuable by-products from the sludge from plain subsiding basins. At Cassel, Germany, sludge so produced was heated to boiling, acidified, filter-pressed, dried, and the grease then extracted from the dried mass with benzine. The extracted grease was then distilled with superheated steam. This plant failed to pay the cost of operation, notwithstanding the fact that the dried sludge contained 18 per cent. of grease, and the wet sludge produced 10 per cent. of

* Rideal, S., 1916. Recovery of Fats and Nitrogen from Sewage. Proceedings, Association of Managers of Sewage Disposal Works, *59*, 571.

cake, having a fertilizer value of 32.5 cents per 100 lbs. in addition to its grease value. (The distilled grease sold for $4.87, and the tarry residue left behind in the still for 41 cents per hundred pounds. The yield of the refined geease was 60 per cent. of the crude.*)

Experiments were conducted at the city of Frankfurt† to determine the feasibility of recovering the values contained in sludge. They are of chief interest in connection with this article in showing that the sludge when acidified with sulphuric acid yielded three times as much grease as the unacidified sludge.

In Wolverhampton, England, a process has been adopted based upon experiments of Dr. J. Grossman, of Oldham, England. The process was patented in 1908.‡ The sludge is partially dehydrated by adding 0.3 per cent. by weight of sulphuric acid to the sludge precipitated in the subsiding basins. After treatment with acid, the clear liquid is drawn off from beneath the scum, leaving a concentrated sludge, said to contain 75 per cent. moisture. This acidified and concentrated sludge is distilled with superheated steam in an externally fired, cylindrical still containing a hollow agitator with perforated radial arms through which superheated steam is passed. The process is reported profitable.

In addition to the above, many attempts have been made to utilize the sludge from chemical precipitation plants, using lime and ferrous sulphate as precipitants, but so far they have been unprofitable.

In recent years engineers have turned very generally to the biological processes of sewerage purification, chiefly to the method of disposal by bacteriological oxidation. In doing so, they have planned their works to oxidize the organic matter contained in sewage and to reduce the sludge by digestion. The plan has been considered most successful which produced most economically the highest degree of oxidation, or, as often expressed, the

* Hopfner and Paulmann, 1902. Die Verarbeitung der Rückstande aus der Schmutzwasser Reiningungsanlage der Stadt Cassel. Mit. a. d. König. Prüfungsanstalt f. Wasser. und Abwasser, *1*, 146.

† Bechold, 1899. Untersuchungen an dem Klärbeckenschlamm zu Frankfurt a. M. Zeitschrift für angewandte Chemie. *12*, 849.

‡ English Pat., 16, 397, August 4, 1908.

highest degree of nitrification, also the least and the least offensive sludge. The plant which best embodies these ideas comprises an Imhoff tank and a bacterial filter bed.

With one exception, no by-products of any considerable value can be recovered to offset the cost of treatment by oxidation. The one exception is the activated sludge process. This is a combination of a physical and a biological process, in which part of the organic matter is destroyed and a very complete separation of the suspended and liquid portions of the sewage is brought about. The process has the further advantage of producing an effluent of good appearance and low bacterial content, which can be discharged into many bodies of water with impunity. This feature and that of easy sludge separation have stimulated engineers to recover the fat and fertilizer values which exist in the bulky activated sludge. It is claimed by many that products of enough value can be recovered to gain a small profit over and above the cost of handling the sludge, but this value will not entirely offset the cost of the whole process. However, it will probably outweigh the cost of sludge disposal. The whole process marks a notable advance. It may be regarded as the climax of the biological processes, and if the net cost, including the cost of aëration and recovery of valuable products, may be brought within reasonable limits, the process may be applied in many cases where the conditions are favorable. It is not applicable to sewages containing those manufacturing wastes which retard bacteriological action.

The activated sludge process, and one other process to be described shortly, have served to re-stimulate interest in the possibility of recovering enough valuable products to make their values important factors in the economy of sewage disposal processes. That other is a new chemical precipitation process known as the Miles acid process, and to describe it and to indicate its possibilities is the object of this paper.

The Miles Acid Process.

History.

Beginning about the year 1900, Mr. George W. Miles, a well-known Boston chemist, with the coöperation of the officers of the Boston Sewer Department, suggested the use of acid to accelerate the precipitation and separation of sludge, and proposed to recover fats and fertilizer from the sludge so produced. The most important factor in the new process consists in the application of the acid to the sewage itself, rather than to the sludge precipitated therefrom; and it lays emphasis upon the decomposition of the soluble soaps and the liberation of the fatty acids,* which latter do not appear as fats when unacidified sewage is tested by standard methods, and are only partially precipitated with the sludge in plain subsiding basins. Furthermore, Miles has suggested the use of sulphur-dioxide gas rather than the sulphuric acid† made from it, thereby avoiding several expensive steps in its manufacture and greatly reducing the cost, besides bringing into play the disinfecting action of the sulphur-dioxide gas upon the sewage itself. If desired, a combination of sulphuric and sulphurous acids may be used.

Sodium acid sulphate (niter cake) is the waste product from the nitric-acid plants, and, as a result of the war, there are

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* Most fats are combinations of glycerine with fatty acids. Soaps are combinations of fatty acids with sodium or potassium. Soaps are soluble, and if a sewage containing them be evaporated, and the residue extracted with ether (the ordinary method of obtaining the fats), the fatty acids in the soaps are not dissolved. On the other hand, if acids be added, they decompose the soaps, set free the fatty acids, and then, if the sewage be evaporated or extracted with ether or another solvent, the fatty acid is dissolved with the true fats. The fatty acids recovered by the extraction of the sludge from acid-treated sewage, may be remade into soaps by treatment with soda or potash.

† Theoretically, sulphuric acid is oxidized sulphur plus water, that is:

$S + O = SO_2$ (Sulphur Dioxide)

$SO_2 + H_2O = H_2SO_3$ (Sulphurous Acid)

$H_2SO_3 + O = H_2SO_4$ (Sulphuric Acid)

Sulphurous acid is more effective than sulphuric acid for treating sewage. Furthermore, its use avoids the cost of oxidizing the sulphur dioxide. This is ordinarily accomplished by the use of nitric acid and the oxides of nitrogen in what is called a "lead chamber," into which nitrogen trioxide (N_2O_3), steam and air are introduced with the sulphur dioxide. The more modern way is to produce oxidization by direct contact of sulphur dioxide, oxygen and water with spongy platinum or some other catalytic agent, activated by electricity. From either the old or the new process dilute sulphuric acid results, and the cost of concentration as well as the cost of transporting the water, which is a necessary part of the finished product, ordinarily enter into the cost of sulphuric acid. It must, therefore, be added to the cost of sewage treated when sulphuric rather than sulphurous acid is used.

enormous quantities of this material piled near nitric-acid plants, for which there is now little use. At the present time this is the cheapest source of sulphuric acid. Before the war, the cheapest source was either sulphur or pyrite (ferrous sulphide).

Experiments.

Experiments conducted by one of us (E. S. D.), and by other officers of the Sewer Division of the city of Boston, were made at different times between June 20, 1911, and June 29, 1914. In all, eleven runs were made at different times during the four years, and 25 986 gals. of sewage were treated. The quantities of products recovered per million gallons of Boston sewage, during these experiments, were, as averaged, 1 738 lbs. of dry sludge, containing 21.7 per cent. or 436 lbs. of grease, and 1 361 lbs. of fertilizer base, having an ammonia content of 4.5 per cent.

Early in 1915, one of us (E. S. D.) delivered a lecture before the students in the Public Health Department of the Massachusetts Institute of Technology, on the possibilities of the Miles process. The subject, as presented, greatly interested Prof. William T. Sedgwick, who later arranged with Mayor Curley for a large-scale experiment at the joint expense of the city of Boston and the Sanitary Research Laboratory of the Institute.

In the Technology experiments two continuous runs were made, one of seven days in July, and one of three days in November, 1915; and the volume of sewage treated averaged 8 241 gals. daily. The experiments are described elsewhere,* but the results obtained during the city's experiments were almost duplicated, as the following table shows:

During the summer of 1914, Mr. Langdon Pearse, division engineer of the sanitary district of Chicago, made experiments† to learn whether acidification could increase the yield of fat from the Center Avenue sewage. Tests in barrels and in a tank holding about 1 500 gallons were made under his direction. A three-hour period of subsidence was used, and the alkaline sewage re-

* Weston, R. S., 1916. Tests of a New Process of Sewage Purification, with Grease Recovery and Apparent Profit. American Journal of Public Health, *6*, 334. Reprinted in Boston City Record, March 3, 1917.

† Sanitary District of Chicago, Report on Industrial Wastes, 1914, pp. 191–194.

quired about 3 200 lbs. of 100 per cent. H_2SO_4 per million gallons. Sulphur dioxide was not tried.

Pearse's results showed that acid treatment produced a higher recovery of fat, namely 69 per cent. of that in the sewage as compared with 47 per cent. obtained by plain subsidence for three hours. The sludge, which amounted to 2 275 lbs. per million gallons, contained, on an average, 93 per cent. of moisture and 25 per cent. of fats. The results also showed a great reduction in oxygen demand,— 170 per cent. of that obtained by an Emscher tank. They also showed a removal of 71 per cent. of the suspended matter.

TABLE I.

COMPARISON OF AVERAGE RESULTS OF TREATING SEWAGE WITH SULPHUROUS ACID, AS SHOWN IN EXPERIMENTS BY E. S. DORR AND M. I. T. SANITARY RESEARCH LABORATORY, 1912–1914 AND 1915, RESPECTIVELY.

	Experiments by E. S. Dorr.	Experiments by M. I. T. Sanitary Research Laboratory.
Average daily flow of sewage during experiments, gallons	92 514 647	103 498 049
Average amount of dry sludge, pounds per million gallons of sewage	1 738	1 909
Average percentage of grease in dry sludge	21.7	22.66
Average amount of grease precipitated from sewage, pounds per million gallons	436	430.1
Average amount of sulphur dioxide used, in pounds per million gallons	*2 300	1 963

Much more extensive experiments have been conducted by Prof. C.-E. A. Winslow of the Yale University Medical School, and Dr. F. W. Mohlman, now chemist of the Connecticut State Department of Health. The results of these experiments have been embodied in a paper read in September, 1918, before the American Society for Municipal Improvements at its meeting in Buffalo and abstracted elsewhere.†

The experiments were conducted at New Haven under the auspices of a special committee, and consisted of four long-time runs with the sewage from the East Street sewer, and one run

* Approximate.

† *Engineering News-Record*, *81*, 1034–1036. Also *82*, 32–36.

with that from the Boulevard sewer, the former runs varying from twenty-four to seventy days, the latter being twenty-nine days' duration. Alongside the experiments with the Miles acid process, there were conducted experiments with screens, with the activated sludge process, and with Imhoff tanks and with plain subsiding basins, with and without chlorine disinfection.

In the experiments with the Miles process, the sewage was acidified with sulphur-dioxide gas, and a four-hour period of subsidence was provided. The alkalinity of the East Street sewage

TABLE 2.

CHARACTER OF MILES ACID SLUDGE AT NEW HAVEN.

	East Street Sewer.				Boulevard Sewer.
Length of run	25 days	24 days	44 days	70 days	29 days
Total gallons sewage treated	260 000	239 400	407 820	602 220	145 500
Pounds of wet sludge per mil. gals. sewage	3 750	4 025	3 200	2 600	5 375
Specific gravity	1 067	1 048	1 054	1 061	....
Per cent. moisture	86.6	88	86.3	85.7	92.5
Pounds dry sludge per mil. gals. sewage	503	483	439	368	403
Ether extract, per cent. dry sludge	23.7	24.0	29	32.6	30.9
Ether extract, pounds per mil. gals.	119	116	127	120	124
Volatile matter, per cent. dry sludge	47.2	51.2	57.3	63.8	78.5
Nitrogen, per cent. dry sludge	1.6	1.6	2.4	2.0	3.0

was very low, so that it was necessary, to secure an excess acidity of 50 p.p.m., to add only 700 lbs. of gas per million gallons of sewage treated. With the Boulevard sewage, 1 130 lbs. of acid per million gallons of sewage were required to secure the same excess acidity (computed in terms of calcium carbonate).

The treatment removed from 61 per cent. to 66 per cent. of the total suspended, and 90 per cent. of the settleable solids. The removal of bacteria was all that could be desired, the two last experiments, with the East Street and Boulevard sewages respectively, indicating removals of over 99 per cent. of the total bacteria, and of the gas-forming organisms.

The use of acid accelerated the precipitation of the suspended solids by about 50 per cent., only 40 per cent. being removed from the untreated sewage by plain subsidence as compared with 60 per cent. when the Miles process was used. The data regarding the production of sludge are as follows:

Opposed to these very favorable results is the presence in the grease extracted from the sludge of a large proportion of unsaponifiable material (waxes, mineral oils and similar substances). Substances of this kind are practically worthless, and their removal is attended with a great deal of expense. The sludge from the East Street sewers contained 24 per cent. of grease, 46 per cent. of tankage and 28 per cent. of water. The grease had the following composition:

	Per Cent.
Moisture and volatile matter	11.0
Unsaponifiable material	21.1
Free fatty acids	40.2
Neutral grease	22.3
Insoluble soaps	3.3
Per cent. of resin in free fatty acids	14.4

The degreased sludge had the following composition:

Ammonia	3.91 per cent.
Phosphoric acid, P_2O_5	0.96 per cent.

Winslow and Mohlman are advised by experienced users of grease that it would be necessary to distill the crude extracted product in order to produce a salable grease. This fact has been recognized, and, on the basis of distillation experiments, they estimate that the grease in the East Street sewage would be worth \$5.00, and the fertilizer \$2.09 per million gallons, — a total of \$7.09, net, — while the grease value of the Boulevard sewage would be \$8.50, and the fertilizer value \$2.88 per million gallons,— a total of \$11.38, net.

Conditions at New Haven are such that the effluent must be clarified and disinfected, but not necessarily nitrified. These conditions are favorable to the Miles process, to Imhoff tanks

combined with chlorination, and to fine screening combined with chlorination, respectively. The activated sludge process would not work because of the presence of copper salts in the sewage.

The operation costs of the disposal plant are estimated in the following tables:

TABLE 3.

ESTIMATED COST OF TREATMENT OF EAST STREET SEWAGE.
DOLLARS PER MILLION GALLONS.

	Miles Acid Process.	Imhoff Tanks and Chlorination.	Fine Screens and Chlorination.
Tanks and buildings (interest and depreciation)	\$2.47	\$5.28	\$4.60
Acid treatment	6.93		
Drying sludge	2.09		
Degreasing sludge	1.78		
Redrying sludge	.17		
Superintendence	1.06	.46	.46
Labor on tanks and screens	1.00	1.20	1.42
Disposal of sludge or screenings		1.00	.50
Chlorination		4.05	4.05
Gross cost	15.50	11.99	11.03
Revenue	6.57		
Net cost	8.93	11.99	11.03

TABLE 4.

ESTIMATED COST OF TREATMENT OF BOULEVARD SEWAGE.
DOLLARS PER MILLION GALLONS.

	Miles Acid Process.	Imhoff Tanks and Chlorination.	Fine Screening and Chlorination.
Tanks and buildings (interest and depreciation	\$2.47	\$4.44	\$4.60
Acid treatment	10.74		
Drying sludge	2.04		
Degreasing sludge	1.91		
Redrying tankage	.17		
Superintendence	2.65	1.15	1.15
Labor on tanks and screens	1.00	1.50	2.05
Disposal of sludge or screenings		1.00	.50
Chlorination		4.05	4.05
Gross cost	20.98	12.14	12.35
Revenue	10.66		
Net cost	10.32	12.14	12.35

The results of these experiments have warranted the New Haven Committee in recommending the Miles process for adoption by the city of New Haven, and that a plant be built first at the East Street sewer, which discharges 16 000 000 gals. daily, and, if this plant be successful, the sewage from the other outfalls should be treated.

Winslow and Mohlman's paper is an eminently fair report of the results of a thorough investigation. They have given this new proposition just the treatment it should receive, namely an unbiased discussion to bring out all important points, both favorable and unfavorable. In so doing they have made two criticisms, both of which are unfavorable and call for comment and explanation. F. W. Mohlman* states that the effluent containing as it does bisulphites and free sulphur dioxide, has the power of deoxygenating several volumes of diluting water, and apprehends that a zone of deoxygenated water will be formed about the point of discharge of the acid effluent. Although not so stated, the implication is that such a zone might cause a nuisance or be injurious to fish life. Otherwise there would be no need for considering it a danger. The question raised is whether or not effects would be produced which would call for the aëration of the effluent. Mohlman's laboratory experiments show the effect upon the dissolved oxygen and sulphur dioxide contents of diluting the Miles process effluent with varying volumes of New Haven harbor water. The results are given in the following table:

TABLE 5.

MIXTURE OF HARBOR WATER AND MILES EFFLUENT.

	Effluent.	Harbor Water.	1 Eff. to 2 Water.	1 Eff. to 4 Water.	1 Eff. to 9 Water.	1 Eff. to 19 Water.
Dissolved oxygen	0.8	12.0	1.0	5.0	8.8	11.0
Sulphur dioxide	118	0	8	0	0	0

This table shows that in a dilution of 2 of harbor water to 1 of effluent, the oxygen is reduced from 12 parts to 1 part per

* F. W. Mohlman. Miles Acid Process May Require Aëration of Effluent. *Engineering News-Record*, *81*, 235, August 1, 1918.

million, and the sulphur dioxide from 118 to 8 parts. At a dilution of 4 to 1, the oxygen is decreased five times, and the sulphur dioxide has disappeared. At a dilution of 9 to 1, the oxygen is 73 per cent., and at a dilution of 19 to 1, 92 per cent. restored.

Polluted waters produce nuisances when they putrefy and give off the products of the decomposition of organic matter containing sulphur. They putrefy if the oxygen is exhausted before the organic matter is oxidized. In other words, the bacteria will oxidize the organic matter to the limit of the oxygen, and if any organic matter remains, the bacteria of putrefaction will attack it and produce the well-known conditions.

TABLE 6.

CONTINUOUS AËRATION OF MILES EFFLUENT.

Date.	Sulphur Dioxide, Influent.	P.P.M. Effluent.	Reduction, Per Cent.	Air per Gal. Cu. Ft.
March 6, 1918	99.1	44.9	54	0.10
March 7, 1918	70.4	14.4	79	0.10
March 8, 1918	72.3	14.4	80	0.11
March 9, 1918	69.1	5.2	92	0.10
March 10, 1918	81.3	46.4	43	0.10
March 11, 1918	80.9	36.1	55	0.06
March 31, 1918	53.8	10.2	81	0.10
April 1, 1918	108.5	37.4	65	0.10
April 2, 1918	90.9	26.5	71	0.10
April 3, 1918	71.0	19.8	72	0.10
April 4, 1918	92.2	4.5	95	0.10
Average	78.1	23.6	70	0.097

The Miles acid effluent does not represent the same conditions as those which exist in a deoxygenated, polluted water, because, in the case of the effluent, the deoxygenation has been produced chemically, not biologically, and the organic matter present has been practically sterilized. Furthermore, the settleable solids which might form sludge banks near the point of discharge have been largely removed. Before a nuisance can occur, bacteria must be introduced and be given a chance to multiply. Meanwhile dispersion and dilution are doing their work, and reaëration is taking place. Then there exists the condition of a warm, practically sterile effluent, free from sludge-

forming suspended matter, being discharged into a considerable body of water, to the surface of which it will tend to rise and spread in a thin layer, thereby becoming subject to the reaërating effect of the wind, currents, passing craft, etc.*

Mohlman showed that the sulphur dioxide may be removed by aëration before dilution with harbor water, and after aëration the effluent will not deoxygenate large volumes of diluting water. The average results of various aëration experiments using compressed air admitted through a "Filtros" plate into a shallow aërating tank providing a detention period of thirty-one minutes are as follows:

From the results of these experiments, Mohlman concludes that 70 per cent. of the free sulphur dioxide may be removed by blowing the effluent in a shallow tank with 97 000 cu. ft. of free air per million gallons of sewage. This degree of aëration is about one twentieth of the 2 cu. ft. per gallon commonly used in connection with the activated sludge process.

Oesten, also G. C. and M. C. Whipple, and others, have shown that the aëration of water, which is in this case the interchange of oxygen and sulphur dioxide, may be accomplished more economically by the use of riffles, sprays or cascades, than by aëration with compressed air. The latter method is rarely if ever used in water-works practice. In the case of the Miles effluent we believe that a sufficient degree of reaëration could be secured by discharging the effluent over a series of riffles, or, if that plan were impracticable, by pumping the effluent through a suitable aërator, in the latter case at a cost of less than $1.00 per million gallons.

Fish life could hardly be affected, for the only place where fish could get into any considerable depth of deoxygenated water would be close to the outlet. Elsewhere they would not be affected unless they swam on the surface, which fish would not do ordinarily.

Pearse's statement in connection with experiments at Chicago† — namely, that the acid effluent has a lower oxygen requirement than ordinary tank effluent — is evidence that,

* Mohlman, *loc. cit.*

† Report on Industrial Wastes, *loc. cit.*

while the effluent contains no oxygen, less is required for the oxidation of the remaining organic matter than in the case of settled sewage.

It is therefore our opinion that under ordinary conditions of discharge into rivers or harbors, the dispersion, dilution and reaëration of the acid effluent would be much more rapid than the development of putrefaction and consequent nuisance; and in rare cases where aëration might be necessary it could be accomplished at a cost which would not militate against the usefulness of the process.

The second point, — namely the presence of unsaponifiable matter in the recovered grease has already been referred to above, and it is one of great importance, as it makes necessary the distillation of the grease.

The value of the grease from the Boulevard sewage is estimated at 8.5c. per lb. to the producer. This is the judgment of the Falk Company of Pittsburgh, who distilled a sample of considerable size. This is about one half the current price of good, saponifiable grease, containing less than 4 per cent. of unsaponifiable matter. Evidently the value which has been assigned to the recovered grease in previous statements regarding the economy of the Miles process should be correspondingly reduced.

Massachusetts State Experiments.

The New Haven authors have referred to the report on the Miles process made by Messrs. Goodnough and Clark of the Massachusetts State Department of Health to a commission appointed by the legislature, and presented by that commission to the legislature early in 1918, and have stated that "these Massachusetts experiments [by X. H. Goodnough and Harry W. Clark] were made on a small scale in bottles, and an eighteen-hour sedimentation period was used, which seems somewhat unfair to the acid process which accomplishes the same results in four hours. The disinfection of the effluent, and the freedom of the process from nuisances, is, of course, ignored in such a comparison." As this report is made by a Massachusetts commission,

and because its conclusions are contrary to the New Haven results, we believe it warrants discussion.

The experiments of Goodnough and Clark were made with three 2-gal. samples made up of aliquot hourly portions collected one day each week for several weeks. The sampling was apparently fair, but on account of the infrequency of the samples could not have been as truly representative as the portions of sewage used during the tests made by the Massachusetts Institute of Technology, amounting to a hundred thousand gallons of sewage. The small samples of sewage were acidulated with sulphur dioxide gas, settled, and the sludge collected and analyzed. While it is true that the sewage was treated with acid, enough departures were made from the Miles process so that it can hardly be called a test of that process.

The results compared with the Technology experiments show that 61 per cent. as much acid was used and 75 per cent. as much sludge; and 79 per cent. as much grease was recovered. These lower results may have been due either to a weaker sewage, or to insufficient acidification. But the most radical departure from the Miles process was in the use of an eighteen-hour period of subsidence in place of the four-hour period used in the Miles process. Using the longer period of subsidence, the state authorities came to the conclusion that there was not enough difference (25 per cent.) between the amounts of sludge obtained to pay for the acid used. In this conclusion no attention was paid to one of the cardinal points of the Miles process, namely that acid is used to accelerate precipitation; therefore it was hardly fair to compare it with an eighteen-hour period of subsidence, particularly so because no engineer would ever consider the use of so long a period of plain subsidence for the treatment of sewage.* The plan would be prohibited by the initial costs of the work, the local nuisances produced, and the small amount of purification effected by the treatment. Conditions at Moon Island — where sewage is stored about four hours, on an average — which are bad enough, only approach those which

* It is obvious that if sewage be held for a period of days, all of the settleable solids would subside, and there would be little or no difference in favor of acid treatment, assuming, of course, that fermentation would not interfere with plain subsidence, as might be expected.

would exist were sewage stored eighteen hours before discharge, and it is abhorrent to contemplate what the conditions would be if the sludge from these tanks could not be discharged with the sewage, but had to be otherwise disposed of. These were the conditions which in a great measure prevented the success of the plant at Cassel, Germany.

Apparently the report of the Massachusetts commission attaches little importance to the sterilizing effect of the sulphur dioxide and the absence of local nuisance, although that point was brought out in the report of the experiments conducted by the Massachusetts Institute of Technology. Furthermore, Winslow and Mohlman state that "it is particularly important from the point of view of the practical sewage-works operator to note that both effluent and sludge were so affected by the acid present as to be stable for considerable periods, so that with a plant of this type no local nuisances need be anticipated. During the whole period of our experience, there were only one or two occasions on which slight signs of septic action were noticed in the tank, and the sludge was stored in barrels for weeks without the production of offensive odors." They also state that "above all, however, the thing that counts most heavily in favor of the Miles process under the conditions obtaining at New Haven is its freedom from nuisance."

In view of the local nuisance produced by many a bacterial tank and filter, we believe the stability and freedom from nuisance of the Miles process effluent and sludge are worthy of all the consideration which previous experimenters, with the exception of Messrs. Goodnough and Clark, have given it.

The Practicability of the Process for Boston Sewage.

It is interesting to apply the New Haven estimates of cost to the results of the experiments with Boston sewage which have been made under our direction. These experiments showed that Boston sewage yielded about 1 500 lbs. of degreased tankage, containing 4.53 per cent. of ammonia; also about 400 lbs. of recoverable grease per million gallons. With fertilizer ammonia at $4.00 per unit, the tankage is worth $18.12 per ton, or $13.59

per million gallons of sewage. Using 8.5c. as the price per pound for the recovered grease (which seems fair because this was the estimated value of the New Haven Boulevard sewage which contains about the same percentage of unsaponifiable matter as the Boston sewage), the grease would be worth $34 per million gallons.

Modifying the New Haven costs to correspond with the stronger Boston sewage, we have determined the costs as given in the following table, which also shows the costs of treatment

TABLE 7.

COST PER MILLION GALLONS OF TREATING 100 000 000 GALLONS OF CALF PASTURE SEWAGE DAILY, APPLYING THE UNIT COSTS ESTIMATED BY WINSLOW AND MOHLMAN FOR 16 000 000 GALLONS OF NEW HAVEN SEWAGE DAILY.

	Calf Pasture Sewage.	Boulevard Sewage.
Tanks and buildings	$2.47	$2.47
Acid treatment	18.65	10.74
Drying sludge	10.35	2.04
Degreasing sludge	9.12	1.91
Redrying tankage	.10	.17
Superintendence	1.06	2.65
Labor on tanks and screens	1.00	1.00
Total cost per million gals.	$42.75	$20.98

of the Boulevard sewage of New Haven. We have not used the East Street sewage for comparison because it is not representative; it contains an unusual amount of machine oils and wastes from the metal industries.

In applying the New Haven unit costs, we have made no subtraction on account of the larger plant or the available tanks at Moon Island. Unit costs for all items except superintendence and labor are those used for Boulevard sewage; the unit costs for superintendence and labor are those used for East Street sewage.

The estimated net financial result of operation is given in the following table.

In the above we have estimated the price of ammonia at $4 per unit. This is low at present. When ammonia is worth $4.50 a unit, the gross revenue would be $49.29, and the profit $6.54 per million gallons, and at $4.75 per unit, the gross revenue would be $50.14 and the profit $7.39 per million gallons. While the above estimate shows a profit under present conditions, it is probably true that under pre-war conditions the process would not produce a revenue; and in their conclusion, Winslow and Mohlman state that "our experience with New Haven sewage

TABLE 8.

Estimated Financial Results of Operating the Miles Acid Process at the Calf Pasture.

	Per Million Gallons.
Revenue:	
From tankage	$13.59
From grease	34.00
Total gross revenue	$47.59
Expenses:	
Estimated cost of treatment	42.75
Profit on above basis	$4.84

lends no color to the hope that a net financial profit can be obtained by the use of the Miles acid process, unless with sewage of exceptionally high grease content and low alkalinity."

One may rightly question the values of any conclusions based on pre-war prices, because the present evidences indicate that the prevailing prices will not be lowered immediately, and they may never reach their pre-war level. This is particularly true of labor which is the principal factor in the costs of materials. At present high prices it seems as if the Miles process would be profitable at Boston, and this favorable condition would gradually disappear as the rate of fall in prices exceeding the rate of fall in cost of operation comes into effect.

The materials produced are fertilizer and grease, and it does not seem likely that the demand will decrease rapidly. The ma-

terials used for purification are sulphur, pyrite, niter cake and the sulphur acids. The war has stimulated the production of all these materials, and now that the abnormal demand has ceased they should be cheap.

Therefore we feel that in many cases it is likely that the Miles process might be operated at a slight profit for some time to come, and, in any event, operated at a cost lower than that for any other process producing the same grade of clarification and disinfection.

Other Advantages of the Miles Process.

In addition to the advantage due to the freedom from nuisance, the stability of effluent and sludge, and those due to the compensating value of the recovered products, there are still other advantages which should be reckoned with.

Sanitary Efficiency a Necessary Concommitant.

All are aware that modern sanitary engineers are designing sewage disposal works to purify sewage to the degree to which the body of water into which the effluent is to be discharged demands and as the financial conditions will allow. In so doing they often sacrifice a desirable degree of clarification, as when only subsiding basins or screens are used; or a high degree of nitrification, as when high rates of filtration through coarse material are employed; but with the Miles process it is a fundamental necessity, in order to recover the valuable products upon which the cheapness of the process depends, to at the same time disinfect the effluent and attain a much higher degree of clarification than can be obtained by screening or plain subsidence. Therefore there is little temptation to sacrifice safety for cheapness.

The sludge from the Miles process contains much less moisture than activated sludge, and about the same as the subsiding basin sludge and the Imhoff tank sludge, as the following table shows.

As compared with activated sludge, the advantage of handling less than one seventh of the volume of activated sludge is obvious.

TABLE 9.

Kind of Sludge.	Average Percentage of Moisture in Sludge.	Relative Volumes of Sludges Containing the Same Amounts of Dry Matter.
Activated sludge	98.5	100
Subsiding basin sludge	91.5	18
Miles Process sludge	90.0	15
Imhoff tank sludge	89.0	13.6

Installation Cost.

The devices required for the operation of the Miles process are the following:

Devices for producing sulphur-dioxide gas, and for feeding niter cake or other forms of acid.
Subsiding basins.
Sludge-handling apparatus.
Sludge driers.
Grease extractors.
Grease stills.
Tankage driers and grinders.

While the list is formidable and is enough to rule out the process for small plants, in the case of a city like Boston, however, the cost should not exceed $15 000 per million gallons, daily capacity.

Further Information Necessary.

While all of the large-scale trials of the process have been giving promising results, it is true that the drying and degreasing of sludge has never been practiced on a large scale. All of the estimates are based upon small-scale trials and the opinions of engineers and of manufacturers who have handled similar materials. There is great need, therefore, for a large-scale experiment with normal sewage to determine the actual possibilities in practice. This experiment should be made on a scale large enough to determine beyond all doubt the costs of drying and degreasing and the possibility of marketing the products. It might cost $50 000.

Adaptability of the Process.

In the words of Winslow and Mohlman,— "For communities where clarification and disinfection are desirable,—where screening would be insufficient and nitrification unnecessary,— the process of acid treatment comes fairly into competition with other forms of tank treatment; and that it is particularly suited to dealing with sewages which contain industrial wastes and for use in localities where local nuisances must be avoided at all costs and where sludge disposal could be provided for only with difficulty." This means that in 90 per cent. of the cases where a large volume of strong sewage is discharged, the Miles process is worthy of consideration.

Conclusions.

We conclude the following from the results of the various experiments and studies:

(1) The Miles process will produce a well disinfected effluent from which 90 per cent. of the settleable solids have been removed.

(2) Whereas it requires for its accomplishment devices for the chemical treatment of the sewage and for drying and degreasing the sludge, competent supervision is necessary.

(3) On account of the nature of the plant and the relatively high cost of operation for small installations, it is not well adapted for the purification of small volumes of sewage.

(4) Its operation should cause no local nuisances.

(5) It causes the removal of over 99 per cent. of the bacteria.

(6) The effluent remains stable long enough for the neutralization of the excess acid, and the oxidization of the sulphites and the sulphates by dilution.

(7) As compared with the activated sludge process, the volume of sludge is very small.

(8) Compared with the cost of the oxidation processes, the cost of installation is low; it is somewhat higher than that for Imhoff tanks with chlorination.

(9) The products recovered are valuable, and their recovery would effect a conservation of natural resources.

(10) Apparently it is the most economical process for producing so well clarified and so stable an effluent, and under present conditions it seems as if it could be installed and operated at a profit in those larger cities where the conditions are favorable.

(11) To determine the costs of sludge drying and degreasing more accurately than is possible from the available data, a large-scale experiment is urgently needed.

DISCUSSION.

Harry W. Clark.* — As Mr. Weston has thrown a few bricks in my direction I wish to make one or two remarks in regard to his paper and this process.

In the first place, I feel quite sure that when Mr. Dorr and Mr. Weston read their papers in regard to it a year or two ago, they stated that from their figures a profit could probably be realized from the working of this process; that is, the sale of grease and sludge would more than pay all costs. A year or two ago, as Mr. Weston has called attention to, a commission was formed by the legislature providing for an investigation of the discharge of sewage into Boston Harbor, this commission consisting of Dr. Henry P. Walcott, chairman of the Metropolitan Water and Sewerage Board; Dr. Allan J. McLaughlin, at that time commissioner of the State Department of Health; and Mr. Edward Murphy, then commissioner of public works of the city of Boston. A resolve was passed by the legislature asking this commission "to determine whether there is any practical, economical way of removing from sewage any merchantable products contained therein." This was the commission and the resolve under which Mr. Goodnough and I worked. If you read the resolve you will see that we were not asked specifically to investigate the Miles acid process to determine its value in sewage treatment; that is, from a sewage disposal point of view and in regard to the destruction of bacteria by it, but, as I just said, "to determine whether there is any practical and economical

* Chief Chemist, Mass. State Department of Health, State House, Boston, Mass.

way to remove from sewage any merchantable products contained therein." The resolve carried an appropriation of $5 000, but as it did not seem possible that with this small sum an investigation could be made extensive enough to answer definitely the question asked, the commission decided not to expend any of this money, and of course such experiments as were made by me were on a very small scale.

During the past year, however, we have spent some ten months in investigating a portion of this process on a larger scale with the sewage of Lawrence, and I shall have something to say later in regard to it; but it did not seem from the many investigations at the experiment station of the State Department of Health at Lawrence and from our general knowledge of the subject that this process could be made a financial success; and nothing so far done either by Mr. Weston or at New Haven has changed my opinion in regard to that part of the process.

We had before us, when our report was made, the example of the manufacturers of the city of Lawrence, who discharge, and have continued to discharge for years, in spite of the investigations and statements of the State Department of Health, many thousand gallons daily of very strong wool liquor into the Merrimack River, a liquor much of which contains two hundred times as much grease to the gallon as in the Moon Island sewage, and a very high percentage besides of potash, — a substance of great value, as you all know, but found in only minute amounts in domestic sewage. Within the last two years, however, certain firms, one, I believe the Diamond Match Company, working in conjunction with the American Woolen Company, and another, the North Star Chemical Company, so called, have taken the strongest wool liquor from these mills and have extracted in one case both grease and potash, and in the other case, grease only. None of these business men will take anything but the strongest liquor to treat, however, — that containing the greatest amount of potash and fats, — and there continues to be discharged into the river daily many thousand gallons of wool liquor containing infinitely more fat and potash than found in Moon Island and other domestic sewage. I may add also that these plants would not have been started at Lawrence, nor the money invested there

to carry them on, except for the scarcity of grease and potash due to the world war. With that example before us, we could not quite see how the Miles process could possibly be a financial success to the city of Boston. I have no doubt, however, that the Miles process may have a place in sewage *disposal*, but very extensive experiments will have to be made in regard to the apparatus best adapted and the methods best adapted to drying sludge and recovering and distilling grease, etc., before an absolute statement can be made concerning its value as a recovery process.

Almon L. Fales.* — I think the Miles acid process offers sufficient promise to warrant a large-scale test such as that recommended for New Haven, and therefore I heartily concur in the conclusion of Mr. Dorr and Professor Weston that such a test is needed. It is only in this way that it will be possible to demonstrate whether the Miles process can, in an economical and satisfactory way, without nuisance, be made to yield a sufficient revenue from the sale of grease and fertilizer to render this method less expensive than the well-established method of Imhoff tank-chlorination treatment, for example, which will accomplish the same objects of clarification and disinfection.

The cost of the acid treatment will vary with the alkalinity of the sewage to be treated. For the East Street sewage in New Haven, which is now abnormally low in alkalinity, due to certain industrial wastes, Professor Winslow and Dr. Mohlman estimate the gross cost of treatment by the Miles acid process to be $15.50 per million gallons, against $11.99 per million gallons by Imhoff tanks and chlorination; whereas for the normal domestic sewage from the Boulevard sewer, they estimate the gross cost of the Miles acid process to be $20.98 per million gallons against $12.14 per million gallons by Imhoff tanks and chlorination. In the latter case the net return from recovery of by-products must be more than twice as much as in the former case, to reduce the net cost of the Miles acid process to that of the Imhoff tank-chlorination process without recovery of by-products. The alkalinity of the sewage in different cities will vary with the

* Of Metcalf & Eddy, Consulting Engineers, 14 Beacon Street, Boston, Mass.

alkalinity of the water supply and the presence of acid or alkaline wastes in the sewage.

HARTLEY L. WHITE.* — This problem seems so vital to the welfare of the cities and towns throughout the country, and is one that is going to be of very great interest to my own community, that I have been very much interested in the paper. The question of financial success of a process of this kind seems to me a relative one. If the operation of this process produces a reduction in cost, so that it is possible to use this process rather than some more expensive one, as suggested by Mr. Dorr, then it seems to me that enters into the question of financial success. I do not take it that a financial success in a thing of this sort means that a profit is going to be made out of the effluent or use of the process, — an actual income over expenses. That does not seem to me necessary to constitute a financial success; but certainly this comes the nearest to anything I have ever heard of being a successful treatment of sewage, and one that must interest every city and town, especially inland cities and towns, and also places on the coast but removed from the metropolitan sewers. I have felt for a good many years that the Massachusetts State Department of Health required a higher degree of purification than was actually necessary, and that towns and cities were being put to expense beyond which they ought to go, to produce that purification. I may be mistaken, but that is my impression. Now, if we have a process that will bring about a degree of purification sufficient to allow the effluent to be turned into the nearest stream or tidewater without injury we have something we have been looking for a good many years, and the question of experimentation seems to me of sufficient importance to make it advisable to introduce a bill — why not let it come from the Boston Society of Civil Engineers? — into the legislature, to obtain sufficient funds to carry on some experiments along the lines suggested by this paper. I believe the process is of such general interest and value to the Commonwealth that it ought to be done, and I have little doubt that such a bill would pass.

* Civil Engineer, Braintree, Mass.

George A. Carpenter.* — I should like to ask a question. I understand that the commission at New Haven recommended the adoption of the Miles process for the sewage from one section of the city, but not from what they called the "Boulevard" section. Does that indicate that there is not sufficient flexibility in the process to meet varying conditions, and does it lead to the interpretation that if the process were sufficient in one case, with the passage of time and changing conditions of sewage later on it might become insufficient and inadvisable?

Mr. Dorr. — I have been very much interested in the development of this process, for the reason that it seemed to me to be a reasonable, common-sense treatment of this vexed problem. It certainly is common sense to recover from the sewage whatever there is of value that can be recovered, and use that value as an offset to the cost; and whether that value balances the cost or whether it more than balances it so that it produces a revenue, or whether it does not balance but only reduces the net cost, — economy is there just the same and should be enjoyed; and this process recovers a larger value in total than any other process that I know of. Mr. Weston may not wholly agree with me, but I think in every case it will show a lower net cost than any other process in which there is a good degree of sterilization, and will answer the requirements better. And what are these requirements? Why, to do no more than is really necessary and to do it as cheaply as possible and avoid nuisance at all costs. That is what they want everywhere and is just what this process does, and I think when it becomes better known it will be widely adopted, just for that reason. The reason it is difficult to get communities to treat their sewage isn't because they want to be dirty or impose their filth on neighboring communities, it is because of the cost of the well-recognized processes, which are a serious tax on many communities. Now, if they can be shown a process which is reasonable in cost and satisfactory in itself, and particularly is free from nuisance, I think the situation will be changed and there will not be that

* City Engineer, Pawtucket, R. I.

resistance to health officers. Even if it is self-sustaining, it will be comparatively easy to get action, because none of the other processes are as economical as that. One little point I might make, — Mr. Weston didn't touch upon, — that is, that this is a chemical process; that is, a positive process. It is not subject to any interference from change in temperature, as bacterial processes are. There is also one more point that does not appear in a comparison of the actual costs at the disposal works. Since the process is such that there is no nuisance, it does not need to be located at a long distance from a city. In almost all others there is some nuisance, and for that reason a site is called for at a considerable distance from the city; that means that a large volume of sewage has to be carried by a large sewer for a considerable distance, — sometimes many miles. Now, that can be entirely avoided, for a process that produces no nuisance can be located near the city. This does not show in actual cost of working the process, but is really a saving, just the same.

Mr. Weston. — The New Haven sewage discharges through half a dozen sewer outlets, and two of them were experimented with, — the East Street and the Boulevard. The former discharges a sewage consisting largely of metal-trade wastes, while the latter discharges a sewage very much like that of the city of Boston, — though a little weaker. The Boulevard sewer discharge, however, is small, — only 2 or 3 M.g.d., while the East Street sewer discharges 16 M.g.d. The plan at New Haven is to establish complete works, including drying and distilling machinery, at the East Street sewer outlet, and then, if the plant be successful, build acid-treating plants at the other outlets; obtain the sludge; bring it over to the East Street works and there complete the process. On account of the relatively large overhead cost on the drying and degreasing machinery it wouldn't be practicable to establish a plant at one of the smaller outlets with any chance of its being a success, but there is a chance at the East Street sewer.

I wish to state again that our knowledge of this process is not complete. We know how much nitrogen is in the sewage, how much the acid treatment will probably cost, how much

sludge we can get and how much water it contains. We also agree that the activated sludge process, as claimed, is one which may be operated at a low cost, on account of the recovery of salable products from the very voluminous sludge; but the activated sludge process requires air for aëration, which is nearly as expensive as acid for precipitation. Now, starting on very nearly equal terms, we have, in the case of the acid process, the problem of drying and degreasing a sludge 6-7ths less in volume, containing a little less fertilizer but more grease per million gallons than the activated sludge. Therefore, if the somewhat optimistic claims for the activated sludge process hold good, the claims for Miles process must likewise hold good.

As Mr. Fales and Mr. Clark have both said, there is a lot of work yet to be done, and although a great deal has been done in England and elsewhere the physical problems of drying and degreasing the sludge are considerable. Sewage sludge " balls " in a rotary drier; does not dry to a granular mass like other substances. The balls must be disintegrated before they will dry; and again sludge must be concentrated roughly to 80 per cent. of water (20 per cent. of solids) before it can be put into a drier and handled. That may mean concentration by decantation, or some rough form of pressing, or a little more acidification to dewater the sludge. Also with the Miles process we have an acid sludge yielding an acid grease. Its distillation must be accomplished with superheated steam. Anybody with experience with superheated steam knows that the plant must be well designed and all the features must be worked out by large-scale experiments before the cost can be approximated well enough to enable an engineer to say that he can design a Miles-process plant which will be successful.

I am sure that we had no intention of " throwing any bricks " at Mr. Clark; we simply wished to show that the acid process which was experimented with in accordance with the request of the legislature, to see if recoverable products could be secured from the sewage of Boston, was not exactly what we call the Miles process, — namely, the treatment of sewage with acid with a short period of subsidence, and again we could not understand quite why our more elaborate and longer experiments

showed higher sludge and fat values. However, these latter are discrepancies which might occur again under conditions which may not be anticipated.

Just one word about the practice in the Lawrence mills. It is a well-known fact that wool-scouring wastes can be treated with acid and practically 99 per cent. of the grease removed, and all plants which have used this process during the war have been immensely profitable. I personally know this is true. But the plants in Lawrence (and I say this because we have designed one of them) are all centrifugal-machine plants; that is, plants in which the wool-scouring wastes are treated by passing them, after subsidence, through a special centrifugal machine which does not remove over 60 per cent. of the fats from the stronger wool-scouring wastes. This probably explains, Mr. Clark, why the strongest wastes were used, because if one should take the weak wool-scouring wastes from certain Lawrence mills, containing the effluent from the third and fourth bowls, the results would be disappointing and not profitable.

During the war a large number of mills located away from Lawrence have appreciated the advantage of recovering the centrifugal grease. In fact, outside of one large company, they have generally done so, and have in many cases paid the cost of construction out of profits.

Wool wastes which contain about 1 to 1.5 of potash in combination with organic matter cannot now compete as sources with the waters of western lakes containing as much potash and no organic matter.

However, the paper which we are discussing is about sewage disposal, not about the grease business. The grease business must be attractive to investors to insure success. Cities are compelled to dispose of sewage, and therefore any process like the acid process, which offers the possibility of a good degree of purification at a low cost, should receive the respectful consideration of those interested in sewage disposal, at least until its claims are disproved by a large-scale investigation.

Mr. Clark. — I do not quite agree with what Mr. Weston says about Lawrence. Before the war we could not get any business men or manufacturers interested in the project of re-

covering grease and potash. It is, I have no doubt, a profitable business at the present time, but allow me to repeat that at Lawrence they are still wasting an enormous amount of fatty matters and potash into the river. Mr. Weston states that the centrifugal machines at Lawrence only collect about 60 per cent of the fatty matters. This is probably true, but if they would treat by the centrifugal process much of the liquor still wasted, and still only recover 60 per cent, they would recover many times more grease per gallon, to say nothing of potash, than is found in the richest Moon Island sewage. Let me add also that the centrifugal machines located in the mills are but the beginning of the processes carried on at Lawrence, the concentrated liquor being always treated at the two central plants I have mentioned. I am quite sure, moreover, that Mr. Weston did not design either of these two plants.

I think the Miles process might well be divided into two parts; first, it should be considered as a process for the treatment of sewage with SO_2 for carrying down sludge and thereby clarifying sewage and also sterilizing the sewage; and the second part is the theoretical portion in regard to its value, to the city installing it, as a recovery method, — can it be made profitable? Frankly, I do not think it can, especially as it would be carried on under city control rather than business control. Mr. Weston has criticized the fact that in the experiments made for the commission, the sewage was given eighteen hours' sedimentation both without and with acid treatment. As a matter of fact, however, the sewage collected by employees of the city of Boston was twenty-four hours old when reaching the laboratory, and usually arrived there late in the afternoon. It was then of little account whether it was settled four, eight or eighteen hours; in other words, about everything that was settleable without chemical treatment went down in four hours, and little, if any, more in eighteen.

MR. WESTON.* — This stale sewage was, therefore, not normal.

The speaker would like to close with a personal word:

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* Author's closure.

The acid treatment of sewage has been brought into the public eye largely because of the devotion and initiative of one man, and that man is Mr. Edgar S. Dorr. I would not be here reading this paper to-night if it were not for him. He became acquainted with Mr. Miles some years ago, and they interested themselves in the problem this paper described. Mr. Dorr was unable to see why the process should not be successful if the details could be worked out, as he believed they could. He has always felt that "the only difference between the possible and the impossible is that the impossible takes longer"; and his devotion has renewed interest in the possibility of recovering valuable by-products from sewage. In 1915 he read a very candid and illuminating paper before the officers and students of the Department of Public Health at the Massachusetts Institute of Technology, with the result that Professor Sedgwick, noted for his ability to pick out the good from the trash, thought the subject worthy of consideration and study. In my opinion, Mr. Dorr has been the most important factor in causing other investigators to study this problem, and in giving the Miles process its present standing.

MEMOIRS OF DECEASED MEMBERS.

THOMAS ASPINWALL.*

Thomas Aspinwall, the son of William and Arixene Southgate (Porter) Aspinwall, was born in Brookline, Mass., September 5, 1853, and died in that town, March 2, 1918.

He was educated at private schools in Boston and at St. Mark's School in Southboro, and was graduated with the class of 1876 at the Massachusetts Institute of Technology.

After a short visit to England and France, Mr. Aspinwall in February, 1877, formed a partnership with Edwin H. Lincoln, opening an office in Boston under the firm name of Aspinwall & Lincoln, Civil Engineers and Surveyors, which is still a well-known firm in the city, and one with which Mr. Aspinwall was associated at the time of his death.

He married, on February 3, 1887, Alicia Stuart Towne, of Brookline, and is survived by his wife and two children, Lieut. Thomas Gardener, now serving in France, and Philip Channing.

Mr. Aspinwall's family was one of the most distinguished in the early history of Brookline and Boston. He inherited many of the most excellent qualities of his ancestors, and was at all times a most attractive and delightful companion. He was fond of nature, and as a recreation from professional duties he loved to wander through the woods and fields with gun and dog.

Mr. Aspinwall's tastes were also inclined towards military affairs; between 1879 and 1882 he was a member of the First Corps of Cadets, and later, 1889–91, served as engineer on the staff of General Bridges, with the rank of captain.

Mr. Aspinwall became a member of the Boston Society of Civil Engineers, March 17, 1880, and of the American Society of Civil Engineers, May 2, 1888.

* Memoir prepared by Desmond FitzGerald and Edwin H. Lincoln.

FREDERICK BROOKS.*

FREDERICK BROOKS was the son of Francis A. and Frances (Butler) Brooks. He was born in Boston, Mass., on July 17, 1848, and died in that city, on January 10, 1919.

Fred. Brooks, as he preferred to be known, was a graduate of Harvard in the class of 1868. In college he was distinguished for proficiency in mathematics, a success which naturally led him later to enter the Massachusetts Institute of Technology, where he studied engineering (1868–70). After leaving the Institute he entered the service of Shedd & Sawyer, at that time a leading firm of civil engineers in Boston.

In 1881 Mr. Brooks joined the staff of the Mexican Central Railroad, and for two years was engaged in location on the Tampico Division, where he gained experience in the running of preliminary and location lines, which led to further engagements in similar work for other roads, notably for the Nashua & Lowell Railroad, in whose employ he remained for three years.

Mr. Brooks became a member of the Boston Society of Civil Engineers in 1874, and for the rest of his life was deeply interested in the growth and success of that Society. He was librarian from 1878 to 1881; director from 1890 to 1894, vice-president from 1902 to 1904, and was elected president in 1904. He was first connected with the American Society of Civil Engineers as junior, on June 7, 1876, and on January 2, 1884, was elected member.

In 1890 Mr. Brooks entered the service of the Boston Water Works as an assistant engineer, and was assigned to the South Framingham office, where he remained for eight years, working upon many important problems connected with the maintenance and construction of an extensive system of water supply. When this work ended he returned to his office, 31 Milk Street, and resumed his private practice.

Fred. Brooks possessed a keen literary sense which found expression in the writing of professional papers and in the editing of the *Journal of the Association of Engineering Societies.* His papers were for the most part connected with the proposed introduction of the metric system, a project in which he was

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* Memoir prepared by Desmond FitzGerald.

much interested, but he found time to write on "Mexican Notes," December 19, 1883, and "Sewage Disposal" at Medfield, Mass., July, 1888.

The Association of Engineering Societies was a widespread movement among the local engineering societies for a closer union in connection with the publication of papers. The idea originated with the Cleveland Society in 1881, and it was carried out successfully for many years until the rapid growth of the local societies rendered it undesirable to continue the joint publication. Mr. Brooks served as editor of the *Journal*, 1905–13. The duties were arduous, but he fulfilled them with ability and fidelity.

Mr. Brooks's death was accompanied by several tragic features. His health was already somewhat impaired, when he was awakened during the night of December 13, 1918, by the smell of smoke in his room. After a hasty examination he found that the upper story was on fire. On that floor the housekeeper was sleeping. Without thought of self, he seized a fire extinguisher and fought the fire at close range, so effectively that he had almost mastered the flames when the fire department appeared and completed the work. Mr. Brooks's head, face and hands were badly burned, and he was carried to the hospital, where he lingered until January 10, 1919, when he passed to his long rest.

Fred. Brooks will long be remembered in Boston, where he was for so many years an interesting and prominent member of our engineering fraternity.

CHARLES HEMAN DODD.*

Charles Heman Dodd was born in Worcester, Mass., September 27, 1855, and was the son of Joseph H. and Martha E. Dodd.

He prepared for the Chandler Scientific Department of Dartmouth College at Worcester Free Institute, now Worcester Polytechnic Institute, entering the freshman class in September, 1874.

* Memoir prepared by R. J. McNulty and E. S. Dorr.

Upon leaving Dartmouth he followed the calling of draftsman and mechanical engineer with signal success.

In 1877 Mr. Dodd entered the office of N. C. Lombard, M. E., State Street, Boston, where he studied for three years. From 1880 until 1886 he was engaged in designing machinery, and from then until 1888 was with the Boston Heating Company as chief draftsman. From 1888 and for three years he was draftsman for the Metropolitan Sewerage Commission, and later was engaged with the Plymouth Cordage Company, designing machinery.

In 1892 he was employed by the city of Boston, and from 1903 until the time of his death he was mechanical engineer in charge of the designing department of the sewer service, Public Works Department.

He designed two sewerage pumping stations for the city of Lynn and four for the city of Boston. He possessed inventive talent of a high order, combined with a well-balanced faculty for practical application of ideas to the work at hand.

Mr. Dodd was an ardent yachtsman and a lover of all water sports. He was a member of several yacht clubs and of the Dartmouth Club of Boston. Interested and successful at yacht designing, he spent many of his spare hours at this work.

He was fond of nature and outdoor life in many forms, and was in the habit of taking long walks over the country roads and through the woods and fields, and liked to persuade old friends to accompany him. Because he was captain and stroke of the crew in vain attempts to revive rowing as a Dartmouth sport, he was known in college days, and still is fondly remembered among the Dartmouth men, as "Skipper Dodd."

Mr. Dodd was married, in 1900, to Miss Frances Cox, of Denver, Colo., who survives him. He was a man of sturdy New England type, of high ideals and principles, and possessed the warm friendship of all who knew him well. The end came suddenly, of heart disease, at his home in West Roxbury, on October 27, 1918.

Mr. Dodd joined the Society September 18, 1901.

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BOSTON SOCIETY OF CIVIL ENGINEERS
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PROCEEDINGS

PAPER IN THIS NUMBER.

"The Operation and Maintenance of the Utilities at Army Camps and Cantonments." Geo. A. Johnson.

CURRENT DISCUSSION.

Paper.	Authors.	Published.	Discussion Closes.
"The Disposal of Sewage by Treatment with Acid."	Edgar S. Dorr and Robert Spurr Weston.	April.	June 10.

Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

MINUTES OF MEETINGS.

BOSTON, April 16, 1919. — A regular meeting of the Boston Society of Civil Engineers was held this evening at Chipman Hall, Tremont Temple, and was called to order at 7.50 o'clock by the President, Leonard Metcalf.

There were present 105 members and visitors.

On motion of Mr. Hodgdon the reading of the record of the annual meeting in March was dispensed with, and it was approved as printed in the April JOURNAL.

The Secretary reported for the Board of Government that it had elected to membership in the grades named the following candidates: Members: Elliot Howes Gage, Ralph Temple Jackson, Carl Bicknell Reed and Gorham Horatio Whitney. Junior: John Joseph Falkenberg.

He also reported that, under authority of a vote of the Society at the annual meeting, the Board had appointed the following committees for the ensuing year:

On the Library: S. Everett Tinkham, chairman; Gordon M. Fair, Howard B. Luther, Frank A. Marston, Barzillai A. Rich.

On Publication: Sturgis H. Thorndike, chairman; Sanford E. Thompson, Arthur S. Tuttle.

On Run-Off Available for Water-Power Purposes: Arthur T. Safford, chairman; Harold S. Boardman, Arthur C. Eaton, X. Henry Goodnough, Richard A. Hale, Chas. H. Pierce, Walter H. Sawyer, Charles W. Sherman, W. Frank Uhl, Frank E. Winsor, Dana M. Wood.

On Membership: Harry F. Sawtelle, chairman; Wm. W. Bigelow, Leroy G. Brackett, Arthur C. King, Thomas F. McSweeney, Chas. R. Main, Thornton R. Stenberg, Philip W. Taylor.

On Social Activities: Charles R. Berry, chairman; Armand W. Benoit, Anthony S. Coombs, Harrison P. Eddy, Jr., Ralph W. Horne, Angus B. MacMillan, David Sutton, Philip B. Walker.

On Papers and Program: Leonard Metcalf, chairman; John B. Babcock 3d, John E. Carty, Luzerne S. Cowles, John R. Nichols, Reeves J. Newsom, George E. Russell, Sanford E. Thompson, S. Everett Tinkham, Dana M. Wood.

The following vote passed at the annual meeting was passed a second time as required by the By-Laws, by a unanimous vote:

Voted: That the dues of all members in the military or naval service of the United States or its allies be abated, on request, for the proportional part of the year 1919–20 that they remain in the service; and that a sum not exceeding five hundred dollars be appropriated from the income of the Permanent Fund to reimburse the Current Fund of the Society.

The President called attention to the announcement in the notice of the meeting with relation to the appointment by the Board of Government of a committee to investigate and report

to the Society upon the compensation of engineers, and he urged the members to aid the Board in the selection of a committee which will command the confidence of the members of the Society, by suggesting the names of men most desirable for membership upon this committee.

The President spoke of the proposed meeting in Chicago to be held April 23 to 25 in relation to the creation by Congress of a Department of Public Works, which meeting had been called by the Engineering Council, and to which this Society had been invited to send a delegate. The Board of Government had accepted the invitation and had appointed Past President Frederic H. Fay to represent the Society at the meeting, and the President asked Mr. Fay to say a word about the proposed meeting. Mr. Fay said in part:

"The idea of a National Department of Public Works is an old one. More than thirty years ago this Society was represented at a conference of engineering societies at Cleveland on this matter. Mr. Clemens Herschel chose it for the topic of his presidential address before this Society in 1891, and a quarter century later as President of the American Society of Civil Engineers he again referred to it in his presidential address before that Society. Repeatedly the subject has come up in many ways and at many places. While so far unsuccessful, the fact that the idea will not down is an indication of its merit. At each recurrent period, it has gathered more strength, until now, in the light of our war experiences, there is believed to be a widespread sentiment in favor of the project.

"At the present time, there are twenty-one bureaus of the Government under five different cabinet officers, having to do with engineering, architectural and construction work of a civil character. This is aside from military engineering work such as fortifications built by the Army, and the work of the Bureau of Yards and Docks of the Navy Department. The division of this work among twenty-one bureaus and several departments with the resulting lack of coördination certainly does not promote economy and efficiency.

"During the past two years, the necessity for coördination of effort and the avoidance of overlapping and duplication has been brought forcibly to our attention by the experience of the war At first, various bureaus of the War Department undertook, each for itself, to carry out various kinds of construction work throughout the country, and for a time there was a great

deal of confusion and overlapping, and conditions became almost chaotic. Contractors working under the different bureaus were bidding against one another for labor and for materials, until it was recognized that, if we were to successfully prosecute the war, something would have to be done to coördinate all of the construction activities of the War Department. Meantime, the Cantonment Division of that department, an organization composed almost exclusively of officers enrolled from civil life, set up for the purpose of building the camps and cantonments to house the great army which was being drafted, had carried out its work with such promptness and efficiency that, in the fall of 1917, orders were issued by the Secretary of War directing that thereafter the Cantonment Division should be known as the Construction Division of the Army and should have charge of all construction work for all bureaus of the War Department in this country. Thereafter the War Department construction work proceeded in an orderly and coördinated manner, materials were purchased through a central agency and allocated to points where they were most needed, and to date the Construction Division has carried through most successfully work aggregating in value more than a billion dollars.

"This example of unification of construction work as a war measure has brought strongly to the front, at the present time, a country-wide demand for similar unification as a permanent peace measure. It is now proposed to unite the civilian, engineering, architectural and construction work of the Government under a central control so far as possible, either by establishing a new cabinet officer, that of Secretary of Public Works, or by uniting the various bureaus having to do with work of this nature under an existing cabinet officer, perhaps the Secretary of the Interior.

"Engineering Council, which as you know is a body representing the four national societies of civil, mechanical, mining and electrical engineers, has strongly endorsed the idea of a National Department of Public Works and has taken the first step in the movement toward its accomplishment by calling a conference in Chicago, April 23–25, of representatives of about 180 engineering, architectural and contracting organizations. At this conference, which is nation-wide, the question of a National Department of Public Works will be discussed in all its phases, and if the idea is received with favor by the delegates, as no doubt it will be, definite steps will be taken to introduce into, and secure the passage by, Congress of a measure for this purpose.

"A questionnaire has just been sent out by Engineering Council, asking for expressions of opinion of the organizations

invited to the conference, upon various questions relating to a National Department of Public Works and upon the various bureaus of the Government which should be included therein. It would seem that, at this time, this Society does not have at hand sufficient information to pass intelligently upon this questionnaire in detail, but that we are sufficiently informed to express our opinion upon the general question of the establishment of a National Department of Public Works. Accordingly your speaker offers the following motion:

"*Voted:* That the Boston Society of Civil Engineers approves the general principle that the engineering activities of the Federal Government be coördinated and concentrated, so far as practicable, under a single responsible head; and further approves the action of the Engineering Council, by its chairman, in calling together representatives of the various engineering organizations of the country, for the discussion and study of the subject and the formulation of a definite plan of action in the premises."

The motion was adopted by a unanimous vote.

The President then called on the first speaker of the evening, Lieut.-Col. Benjamin W. Guppy. With the aid of maps thrown on the screen, Colonel Guppy spoke most interestingly, taking for his subject. "A Year with the British Expeditionary Force."

The second speaker was Major Lewis E. Moore who took for his subject "Military Bridges." Major Moore described, with the help of lantern slides, the various phases of military bridge work with which he was engaged while in France, including the design of standards, field reconnaissance, construction of new bridges in the field and maintaining and strengthening of existing bridges.

Adjourned.

S. E. Tinkham, *Secretary.*

ROLL OF HONOR.*

ADDITIONS.

EMERSON, GEORGE D. Captain, Q. M. C., Const'n Div., U. S. A.; Asst Constructing Quartermaster, Boston Army Supply Base.

† MAILEY, J. BRUCE. Signal Corps, Aviation Section, U.S.A.

REVISION.

SPEAR, WALTER E. Major, Q. M. C., U.S.A., Constructing Quartermaster, Camp Upton, N. Y.

LIST OF MEMBERS.

ADDITIONS.

FALKENBERG, JOHN J. .... Mass. Inst. of Technology, Cambridge, Mass.
GAGE, ELLIOT H. .... 518 Main St., South Weymouth, Mass.
JACKSON, RALPH T. .... 3 River-Street Pl., Boston, Mass.
LYONS, TIMOTHY R. .... 294 Washington St., Boston, Mass.
McGOVERN, PATRICK .... 50 East 42d St., New York, N. Y.
REED, CARL B. .... Box 112, Norwood, Mass.
WHITNEY, GORHAM H. .... 35 Irving St., West Medford, Mass.

CHANGES OF ADDRESS.

BARTLETT, CHAS. H., 2632 Whitehall Bldg., 17 Battery Pl., New York, N. Y.
COWLES, M. WARREN.... Care State Dept. of Public Health, Springfield, Ill.
DEMING, GUY S. .... German Valley, N. J.
DORSEY, THOMAS F. .... Box B, Foxboro, Mass.
FEAR, HOLBERT W. .... 74 Prospect St., Gloversville, N. Y.
FIELDING, WILLIAM J. .... Box 592, Cristobal, Canal Zone
FOLEY, ERNEST L. .... 35 Bennington St., Newton, Mass.
GAUTHIER, ALMON I. .... B. & M. R. R., Concord, N. H.
GILES, ERNEST P. .... 303 Ave. E, San Antonio, Tex.
GREEN, HOWARD W. .... 383 South Main St., Woonsocket, R. I.
JOHNSON, FRANK W. .... 822 New Birks Bldg., Montreal, Quebec
LEONARD, JOSEPH F. A. .... 4011 North Main St., Fall River, Mass.
McSWEENEY, THOMAS F. .... 1 Salem End Rd., Framingham, Mass.
PORTER, ARTHUR P. .... 28 Crescent St., Newton Lower Falls, Mass.
RICE, ARTHUR P. .... 45 North Ave., Melrose Highlands, Mass.
Rice, JAMES........ Apt. 51, Gardens Apts., Forest Hills, Long Island, N. Y.
SAVILLE, THORNDIKE........... Univ. of North Carolina, Chapel Hill, N. C.
SHEILS, HENRY C. .... 1079 Columbus Ave., Boston, Mass.
TOSI, JOSEPH A. .... 9 John St., Worcester, Mass.
WEBB, GEORGE F. Care J. B. McCrary Co., 3d Nat'l Bank Bldg., Atlanta, Ga.

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* Members who are in the service and have not yet reported that fact to the Secretary are earnestly requested to do so, stating branch of service, rank and military address.

† Has received honorable discharge.

APPLICATION FOR MEMBERSHIP.

[May 15, 1919.]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

SAVILLE, THORNDIKE, Chapel Hill, N. C. (Age 26, b. Malden, Mass.) Graduate of Harvard Univ., 1914, with degree of A.B., receiving M.S. in 1917; received degree of B.S., 1914, and C.E., 1915, from Dartmouth College; received degree of M.S., 1917, from Mass. Inst. of Technology: specialized in sanitary engineering, geology and public health. From 1907 to 1910, on Panama Canal, work consisting of hydrographic surveying, current-meter observations, triangulation, meteorological observations, etc.; from 1913 to 1915, instructor in surveying, Thayer School of Civil Engrg., Dartmouth College; from 1914 to 1915, assistant in physics, Dartmouth College; from 1915 to 1917, assistant in geology, and from 1916 to 1917, assistant in sanitary engineering, Harvard Univ.; lecturer on sanitation and public health, Dartmouth College, summers of 1916 and 1917; from August, 1917, to March, 1919, in U. S. Army; held rank of 1st lieutenant, Air Service; from January, 1918, to date of discharge, in charge of construction of all water works, sewerage systems and sewage-disposal plants, and subsoil drainage at Langley Field, Hampton, Va.; from March, 1919, to date, assoc. professor of sanitary engrg., Univ. of North Carolina. Elected a junior February 21, 1912, and now desires to be transferred to grade of member. Refers to A. S. Crane, E. C. Sherman, C. M. Spofford and G. C. Whipple.

EMPLOYMENT BUREAU.

THE Board of Government maintains an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society rooms two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

MEN AVAILABLE.

454. Age 22. Educated in public schools. Experience covers two years as computer and assistant land accountant on railroad valuation and five months as rodman on municipal work. Prefers out-of-door work. Salary desired, $18 per week.

455. Age 50. Educated in high and private schools. Experience has been chiefly on municipal work and building construction.

456. Graduate of Lowell high and textile schools. Has had about four years' experience as transitman, during which time has also made computations and done some drafting. Salary desired, $22 per week.

457. Graduate of Rensselaer Polytechnic Inst., 1916. Experience has been on heavy foundation work for steel mills and survey and power-plant work.

458. Age 28. Graduate of Mass. Inst. of Technology, 1913, civil engineering course; member, B. S. C. E. Experience includes three years with Mass. Highway Commission on construction, repair and maintenance of highways, six months on building construction with prominent Boston firm, and two years as officer with 101st Engineers, 26th Div., U. S. A., having returned with rank of captain; recently discharged from service. Desires business position that calls for engineering education and experience. Salary desired, $1 800 per year.

POSITIONS AVAILABLE.

Wanted: Engineer to take charge; also job superintendent. Large reinforced concrete buildings. One job in Boston, one out of town. Must be first class. Benjamin Fox, Inc., 15 Exchange St., Boston, Mass.

LIBRARY NOTES.

Book Review.

Concrete Engineers' Handbook: Data for Design and Construction of Plain and Reinforced Concrete Structures, by George A. Hool, S.B., Professor of Structural Engineering, University of Wisconsin, and Nathan C. Johnson, M.M.E., Consulting Concrete Engineer, New York City; assisted by S. C. Hollister, B.S., Research Engineer, Corrugated Bar Co.; with chapters by Harvey Whipple, Adelbert P. Mills, Walter S. Edge, A. G. Hillberg and Leslie H. Allen. First edition New York, McGraw-Hill Book Co., Inc. Cloth, 6 x 9 in., pp. 885, illustrated. $5.00.

Reviewed by Charles M. Spofford.*

The purpose of this handbook, as stated in the preface, is to make available in concise form the best of present-day knowledge concerning concrete and reinforced concrete, and to present complete data and details, as well as tables and diagrams, relating to the design and construction of the principal types of concrete structures.

A careful examination of the book shows that the authors' purpose has been carried out with thoroughness and clearness. The book contains a vast amount of information and data concerning the materials and methods entering into concrete construction, the properties of concrete and the generally adopted methods of computation. Nowhere else, to the writer's knowledge, has there been collected in one volume so comprehensive a compilation of useful material relating to this important branch of engineering. Moreover, the material is well arranged, the theoretical treatment of the various topics is reasonably complete, and the book contains the most recent developments in the theoretical and practical treatment of the subject.

Several sections deserve special comment because of the original matter which they contain. Among these may be mentioned Section 2 upon "General Methods of Construction"; Section 3, entitled, "Construction Plant"; Section 10, entitled, "Moments of Rigid Building Frames"; Section 11, upon "Buildings" (particularly that portion of it dealing with flat-slab construction); and Section 19, upon "Estimating."

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* Of Fay, Spofford & Thorndike, Consulting Engineers, Boston.

Sections 2 and 3 are of value not only to construction engineers and contractors, but also to designers and draftsmen who may not be thoroughly familiar with the various methods of construction adopted in the field. They contain many well-chosen illustrations as well as diagrams and tables which should be of assistance in designing form work.

Section 10 contains material which, so far as the writer knows, has not before appeared in book form. In this section, the magnitude of the moments occurring in the framework of reinforced concrete buildings under vertical loads, is treated by the slope-deflection method, as outlined by S. C. Hollister, research engineer of the Corrugated Bar Company. Numerous diagrams giving the value of the moments under various conditions of loading accompany the text. This section also contains a brief treatment of the wind stresses in such frames.

The portion of Section 11 dealing with flat-slab construction, prepared by Walter S. Edge, consulting engineer of New York City, furnishes the most complete treatment of this important phase of building construction that the writer has as yet seen. The various systems in common use are clearly described, empirical methods of computing slabs are presented, and a comparison is made of the results obtained by these methods. This section also includes data upon flat-slab patents, as well as the results of many loading tests. Sample computations of typical slabs made by various methods, such as those prescribed by the Chicago and Pittsburgh building laws and by the recommendations of the American Concrete Institute, are given, and should be of great help even to the experienced designer. This section is supplemented by the appendices at the end of the book in which the rulings pertaining to flat-slab design adopted by various cities and associations are printed at length.

Section 19, on "Estimating," by L. H. Allen of the Aberthaw Construction Company, gives an interesting exposition of the methods used by contractors in estimating costs, and has much practical value.

While a large part of the book is devoted to buildings, other forms of concrete structures, such as girder and arch bridges,

dams, standpipes and tanks, chimneys, retaining walls, reservoirs and miscellaneous structures, are treated in detail, both theoretically and practically.

In conclusion, it may be said that this book forms a real addition to engineering literature, and should be included in the library of every engineer and builder engaged in concrete design and construction.

Recent Additions to the Library.

U. S. Government Reports.

Abstracts of Current Decisions on Mines and Mining from January to May, 1918. J. W. Thompson.

America, Americanism, Americanization. Franklin K. Lane.

Asphalt, Related Bitumens and Bituminous Rock in 1917. John D. Northrop.

Coal South of Mancos, Montezuma County, Colorado. A. J. Collier.

Combustion Experiments with North Dakota Lignite. Henry Kreisinger and others.

Contributions to Economic Geology, 1917: Part I.—Metals and Nonmetals except Fuels. F. L. Ransome and others.

Decision as to Wages, Hours and Other Conditions in Atlantic Coast, Gulf and Great Lakes Shipyards by Labor Adjustment Board, October 1, 1918.

Decision as to Wages, Hours and Other Conditions in Pacific Coast Shipyards by Shipbuilding Labor Adjustment Board, October 1, 1918.

Fume and Other Losses in Condensing Quicksilver from Furnace Gases. L. H. Duschak and C. N. Schuette.

Genesis of Ores at Tonopah, Nevada. Edson S. Bastin and Francis B. Laney.

Geologic Reconnaissance for Phosphate and Coal in Southeastern Idaho and Western Wyoming. Alfred Reginald Schultz.

Geologic Reconnaissance of Inyo Range and Eastern Slope of Southern Sierra Nevada, California. Adolph Knopf.

Geology and Ore Deposits of Yerington District, Nevada. Adolph Knopf.

Gold, Silver, Copper and Lead in Alaska in 1917. G. C. Martin.

Gold, Silver, Copper, Lead and Zinc in Nevada in 1917. V. C. Heikes.

Health Almanac for 1919. R. C. Williams, editor.

Labor Saving at Limestone Quarries. Oliver Bowles.

List of References on Panama Canal Zone.

Oxidized Zinc Ores of Leadville, Colorado. G. F. Loughlin.

Plan for Operation of New American Merchant Marine. Edward N. Hurley.

Preliminary Report on Mining Districts of Idaho. Thomas Varley and others.

Production of Lumber, Lath and Shingles in 1917. Franklin H. Smith and Albert H. Pierson.

Quarry Accidents in United States during Calendar Year 1917. Albert H. Fay.

Quicksilver in 1916. H. D. McCaskey.

Relation of Landslides and Glacial Deposits to Reservoir Sites in San Juan Mountains, Colorado. Wallace W. Atwood.

Secondary Metals in 1917. J. P. Dunlop.

Studies on Treatment and Disposal of Industrial Wastes. Harry B. Hommon and Emery J. Theriault.

Sulphur Dioxide Method for Determining Copper Minerals in Partly Oxidized Ores. Charles E. Van Barneveld and Edmund S. Leaver.

Testimony of Matthew C. Brush in Hearing before Committee on Commerce, United States Senate, in Investigation of All Matters Connected with Building of Merchant Vessels under Direction of United States Shipping Board Emergency Fleet Corporation, 1919.

Tin in 1917. Adolph Knopf.

Results of Triangulation and Primary Traverse in Ohio, 1898 to 1911, inclusive. R. B. Marshall.

Water-Supply Papers 414, 422, 425 — D, E.

What the National Forests Mean to the Water User. Samuel T. Dana.

World Shipping Data: Report on European Mission. Edward N. Hurley.

City and Town Reports.

Boston, Mass. Annual Report of Public Works Department for 1917.

Danvers, Mass. Annual Report of Water Commissioners for 1918.

Detroit, Mich. Report of Water Commissioners on Investigation of Detroit Water Supply with reference to Filtration and Other Improvements including Results of Operation of Experimental Filtration Plant, 1919. R. Winthrop Pratt.

Leominster, Mass. Annual Report of Water Commissioners for 1918.

Melrose, Mass. Annual Report of Park Commissioners for 1918.

New Bedford Mass. Annual Report of Water Board for 1918.

Pittsburgh, Pa. Annual Reports of Bureau of Engineering for 1915 and 1916.

Plymouth, Mass. Annual Report of Water Commissioners for 1918.

Rochester, N. Y. Report on Problem of Street Cleaning, 1918.

Woburn, Mass. Annual Report of Department of Public Works for 1918.

Miscellaneous.

P. H. Dudley's Condensed Diagrams of Inspection of B. & A. R. R., 1897. Gift of A. P. Rice.

Highways of Europe. Arthur H. Blanchard. Gift of author.

Modern Methods in Motor Transportation: Report of Proceedings of First Semi-Annual Motor Transportation Conference, 1918. John R. Eustis, Ed. Gift of A. H. Blanchard.

Water Power Engineering. 2d ed. Daniel W. Mead.

LIBRARY COMMITTEE.

Vol. VI MAY, 1919 No. 5

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications

THE OPERATION AND MAINTENANCE OF UTILITIES AT ARMY CAMPS AND CANTONMENTS.

By George A. Johnson,* Lieutenant Colonel, Quartermaster Corps, U. S. A.

(Presented before the Sanitary Section March 5, 1919.)

The construction of the establishments built in the last year and a half by the Construction Division of the army is an achievement unparalleled in the history of engineering. In speaking of it there is always a tendency to draw a parallel between Panama Canal construction and the accomplishments of the Construction Division. You will all recall that ten years were required to build the Panama Canal, at a cost of some $375-000 000. In a year and a half the Construction Division built works totaling a cost of over $1 000 000 000 — nearly three times the cost of the Panama Canal, — and this work was done at a time when there was a shortage of labor and materials, and a congestion of transportation facilities unparalleled in the world's history.

We are now going through a transition period, which in some ways is rather embarrassing. When the armistice was signed we were going strong. If the work had lasted six months longer, we would have accumulated the prettiest line of statistics on the cost and efficiency of utilities operation and maintenance ever recorded. Even so, we have already compiled from our

* Assistant to officer in charge of Maintenance and Repair Branch of the Construction Division, U. S. A., Washington, D. C.

records accurate figures of cost and efficiency in all the different branches of the utilities under our management. We are thus able to say and to prove by these records that the utilities in some three hundred and fifty-odd military establishments have been administered by the Division in a thoroughly effective, efficient and economical manner. That in itself should set apart the Construction Division as a somewhat unusual organization, because it is not unknown that such a record is not strikingly common of the management of governmental affairs. We know and are able to prove that we are obtaining water supplies, disposing of sewage, obtaining electric current for light and power, operating heating plants, manufacturing ice and maintaining buildings and roads at a cost equal to or better than the best managed commercial enterprises. Now, that is an accomplishment, and it has only been made possible by this wonderful force of skilled men who had made a success of similar work in civil life and who so willingly lent their services to the Government in this emergency.

This tremendous building program, entailing a cost of some $1 200 000 000, was carried through with a profit to the contractors of less than 3 per cent. It is a wonderful thing, and strangely enough the magnitude of these works is but little understood. When you consider, for example, that the storage warehouses constructed by the Division would make a building 70 ft. wide and 100 miles long, you get a faint idea of the problem. You get another when you realize that in the original 32 camps and cantonments alone the total number of buildings is over 55 000. Now, all of these buildings, all of the roads (there are some 750 miles of roads in the camps and cantonments and some 450 miles in the port terminals, hospitals and regular army stations), the heating plants which require annually nearly a million tons of coal, the refrigeration plants providing ice for the preservation of perishable foodstuffs and for issue to troops, electric light and power plants, the water and sewer systems (there have been laid 3 500 000 ft. of wood-stave pipe on the water-works end, which is quite a tidy little piece of pipe laying), all require to be kept in good repair and the machinery operated efficiently and economically. That is our job, and the greater

portion of the burden falls upon the utilities officer at each establishment, who must be a homogeneous combination of building superintendent, superintendent of highways, heating engineer, refrigerating engineer, electrical expert, water and sewer superintendent, and fire marshal, as well as a diplomat of no mean ability. I say with confidence that we have dozens of just such men in the organization.

It is doubtless unnecessary for me to tell you much about the organization of the Construction Division. Last week I read an article in the *Engineering News-Record*, written by Mr. George W. Fuller, which describes quite clearly just what this organization is. There has been, however, a misapprehension in the minds of many people as to just what the term "Construction Division of the Army" means. The layman takes it for granted that the Construction Division is a part of the Corps of Engineers of the United States Army. Actually, nothing is further from the truth. The Corps of Engineers is a regular army organization, primarily interested in work connected with the activities of combatant troops. The Construction Division is a corps of engineers recruited from civil life to do work in the United States for the army which the Corps of Engineers has never done. Thus, the distinction between the two organizations becomes very plain. There have never been connected with the Construction Division more than three regular army officers since it was formed. Such members of the Engineer Reserve Corps as did become a part of it were originally recruited from civil life and were later attached to the Construction Division.

Although the officers of the Construction Division wear the insignia of the quartermaster-general's office, they are a part of that organization only because their commissions so read. The Division is in fact a separate corps, — just as is the Motor Transport Corps, for example, — and reports direct to the chief of staff and not through the quartermaster-general. It has its own funds, and disburses those funds without further reference than to the director of operations who is a member of the general staff.

Before getting into a detailed discussion of the functions of the Maintenance and Repair Branch in the operation of army camp utilities, I want to make one more general statement

concerning a sentence which appears in the announcement of this meeting. In this announcement reference is made to the "Manual of Operation of Water and Sewage Works" issued by our office for the guidance of the officers in the field, and which the writer of the announcement admits is the most complete and comprehensive document on the subject ever written. It may be that undue credit will thus be given Major Messer and myself for the preparation of this manual, but the fact is that Mr. Fales, a partner of Mr. Metcalf, spent about six weeks in Washington on the preparation of this manual, while Major Messer and I occupied the positions of editors in connection with the work, striking out here and adding there, and making things fit generally. Consequently, we do not want to take the credit, or the bulk of the credit, for its preparation, notwithstanding it is a very fine document, for basically it was Mr. Fales's creation.

Personnel of the Maintenance and Repair Branch.

At the beginning of this year the personnel of the Washington office consisted of 34 commissioned officers (of which 13 were attached) and 126 civilian employees, nearly half of the last named being engaged on work for the entire Construction Division in the drafting, photostat and blue-print rooms.

Assisting Colonel Hartman in the Washington office are the various chiefs of sections, with their commissioned staffs and a force of civilian employees, among the latter being many of long and valuable experience in army work. This headquarters organization handles individually and collectively all inquiries, requests for information and requisitions forwarded by the camp utilities officers. The officers in the Washington office and at the camps are technical specialists, trained in civilian life in the operation and general management of public utilities.

In the camps the unit forces are composed of similar men, and consist of a utilities officer in charge, a commissioned staff of about a dozen men, and enlisted personnel ranging in number from 300 to 800, depending upon the size of the establishment.

On January 1, 1919, the personnel of the Maintenance and Repair Branch in the Washington office and in the field totaled 501 commissioned officers and 17 995 enlisted men.

Functions of the Maintenance and Repair Branch.

The Maintenance and Repair Branch of the Construction Division is charged with the operation, maintenance and repair of utilities at military posts, camps, cantonments, hospitals and other organizations coming within the jurisdiction of the War Department in the United States and dependencies. It has administrative charge, and therefore obtains the necessary authorizations, establishes policies and fundamental standards relating to the operation and maintenance of water supply, sewerage and drainage, electrical, heating, refrigeration and fire-prevention systems, the upkeep and repair of buildings, roads and other fixed properties at such establishments. It exercises supervision over new construction of lesser magnitude, and additions and extensions to existing plants and systems. Especially is this true at posts or camps where constructing quartermasters have been withdrawn upon the reduction of construction work to a point where it can advantageously be handled by the utilities organization.

The Maintenance and Repair Branch selects officers to operate the utilities in these establishments, and directs and supervises their work. It makes allotments for maintenance and repair work from funds provided for such purposes. It consults with the Engineering Branch of the Construction Division that the data collected from actual operating experiences may be utilized to the best advantage in connection with the laying out of new work. It coöperates with all departments of the Construction Division, that conflict of ideas and policies may be reduced to a minimum, and that the general efficiency of the work of the entire Division may be maintained on the highest plane possible. It maintains such records as are necessary and of historic value concerning the projects in its charge.

On January 1, 1919, there were under the jurisdiction of the Maintenance and Repair Branch the roads, buildings, and public utilities in 46 camps and cantonments; 51 hospitals; 66 border stations; 25 supply depots and terminals and 171 regular military posts, — a total of 359 military establishments. The apportionment of funds for the use of the Maintenance and

Repair Branch for the fiscal year 1919 amounts to a total of \$62 400 000, or approximately \$1 200 000 per week.

Personnel Section.

The Personnel Section acts for the officer in charge of the Division in the appointment, promotion, elimination and assignment of officers; and the procurement, assignment and promotion of enlisted personnel. It performs certain routine functions not readily susceptible of delegation to other sections, keeps a record of commissioned and civilian personnel assigned to the Division, and coöperates with the Administrative Division as to personnel, policies and procedures.

Service Section.

This section has general supervision over all matters coming before the Branch. The mail of the Branch is first referred to this section, which handles matters not requiring expert technical investigation and decision without further reference to the specific section involved.

Construction, repair and maintenance of roads, walks, wharves, sea walls, retaining walls and drainage systems, dredging operations, care and improvement of grounds, are handled in their entirety by this section, as is also the routine of procurement of all materials required for the maintenance and repair of all buildings and systems.

Requests for authority for the purchase of supplies of various kinds are scrutinized in order to avoid errors in stating allotments to which charged, and all requisitions and matters pertaining thereto are acted upon in this branch.

Statistical Section.

This is the accounting, statistical and historical record section. Day-to-day balances are kept of the different apportionments of appropriations, and a complete record is kept of the purposes for which moneys have been expended from any allotment. Monthly reports from camps, cantonments, etc., are carefully checked and then filed in this section, as are all statistical records referring to the work of the entire Division. The histori-

cal record of the construction of each camp, cantonment, post, etc., is in the custody of this section. The preparation of maps and other drafting, blue-printing and photostat duties for the entire Construction Division are performed in this section.

Procurement Section (see Service).

The tabulation of annual repairs to buildings, systems, etc., at military posts and stations; requisitions for heavy furniture for officers' quarters; portable refrigerators; wall lockers; purchase of building materials for the Philippine Islands and Hawaiian Islands; feed boxes; coal boxes; shelving. Moving-picture outfits and rental of films are among the matters handled by correspondence in this branch, as is tent-floor construction, window screening, screening of buildings, storm doors and window shades.

Building-Repair Section.

This section exercises supervision over matters relating to location, construction, repair and extension of buildings for the shelter of officers and enlisted men, animals and stores; and for other military activities, and for administrative purposes. The construction of fences, the installation and repair of buildings, of elevators, laundry and post bakery buildings. In general, all means taken by the Government to house men and animals, and store supplies are handled by this section.

Fire-Protection Section.

This section exercises supervision over building plans with reference to fire prevention, formulates fire rules and regulations, and approves and directs the purchase and repair of fire-alarm systems, and fire-fighting apparatus and appliances.

Light, Heat, Power and Refrigeration Section.

Supervision of the operation and maintenance of the entire electrical service is handled in this section. The work includes analysis and approval of electrical contracts when energy is purchased, construction, operation, maintenance and repair

of power plants, including heating, refrigeration, pumping and electric-lighting systems, lighting fixtures and purchase of light and heat; incandescent lamps; saw mills and saw-mill equipment; supply parts; construction and repair of central and individual heating plants; inspection of boilers.

Water and Sewer Section.

This section supervises the operation, maintenance and repair of water-distributing systems, water-purification systems, pumping stations, sewerage systems, sewage treatment and disposal plants, incinerators and odorless excavators; and directs the installation and maintenance of plumbing in all buildings throughout the camps. It is responsible for the satisfactory operation of municipal water works from which military establishments are supplied, with particular reference to the adequacy and purity of the water furnished. It also handles the purchase of water by passing upon and approving all water contracts.

Utilities Officers' Reports.

The Washington office, in its endeavor to supervise intelligently the utilities in camps scattered all over the United States, requires to be kept advised as to what is going on and what are the actual needs in the camps. The utilities officer depends on this office for prompt assistance in authorizing funds for repairs and extensions, and also for advice on matters of policy and many other things.

There are two methods of acquiring information, namely, by reports of inspectors sent out to investigate, and by study of the reports of the utilities officer. It is very clearly realized that the utilities officer is kept busily engaged if he is efficiently performing the duties connected with the administration of his office, and for that reason the Washington office endeavors not to require him to do any more routine report work than is absolutely necessary. The report forms which he is required to fill out and submit at monthly intervals have been made as simple and as few in number as possible; but even so they are quite voluminous.

The monthly report from each camp contains concise statements relative to the activities of each section of the camp utilities. Until July, 1918, the arrangement and form of report was left almost entirely to the discretion of the several utilities officers. Commonly, however, a summary is given at the beginning, outlining matters of particular importance, recommendations as to needs, and what not, this being followed by detailed statements covering each of the utilities. Those utilities officers with municipal experience doubtless had the idea at first that reports were only necessary evils in connection with the job, and consequently to be suffered patiently. Actually, though, they serve a very useful purpose, — that of conveying essential information in a decisive fashion.

One of the greatest deficiencies in the early reports received from utilities officers, and in their requests for funds and authorizations, was the lack of complete explanation of the specific requirements. This caused delay in definite, final action which could easily have been avoided. Frequent circular letters of instructions as to the proper procedure for them to follow gradually smoothed out these difficulties. Still further to convey helpful instruction in this regard to the utilities forces in the field, whenever a letter or report is received from any camp which contains helpful hints, descriptions of the unique and resourceful manner in which a utilities officer overcame some difficulty or performed some unusual service, those parts of his communication are mimeographed with comments thereon by the officer in charge of the Division, and copies forwarded to the utilities officer at each camp for his information.

The reports from utilities officers do not meet the quite common fate of being filed away in the archives without examination. On the contrary they are carefully studied; first, with the object of finding out what has occurred during the month previous; and, second, to analyze the accumulated data from the viewpoint of efficient and economical operation. The reports on being received at the Washington office are scrutinized carefully by the various section chiefs, who attach memoranda to the report before passing it on to the officer in charge of the Division, where it is again studied, questions of policy and condi-

tions requiring correction are noted, and a communication with instructions, prepared with the aid of the various memoranda attached by the section chiefs, forwarded to the utilities officer. Thus the officer in the field has reason to feel that his reports serve a useful purpose; that the time spent in their preparation is well spent; and that prompt coöperation and assistance on the part of the Washington office depends quite materially on the character and completeness of the information furnished it with respect to his needs.

Road Repair.

There is no question that good roads and tidy-looking buildings go a long way toward creating a favorable impression in army camps. This branch makes a special effort in that direction, although handicapped by the lack of painting on the buildings and by the extremely heavy use to which the roads are put and the difficulty in getting competent labor to keep them up. This is important for other than psychological reason s. It is to be recalled that every man in the camp either walks or rides over the various avenues of travel several times daily, and uneven footing or rough riding not only produces discomfort but reduces efficiency, and very substantially increases the wear and tear on the rolling stock in the camp, and in consequence decreases its usefulness and adds materially to the cost of its upkeep. The utilities officers in the field have been urged to keep these thoughts constantly in the foreground, and authorizations of money and materials are always promptly forthcoming whenever requisitions are prepared in a clear manner describing the work to be done, its location, and when accompanied by a decisive statement setting forth the advantages which will accrue from such work. Where the utilities organization is short of labor, a certain amount of energy, properly applied, has resulted in the detailing by the commanding officer of sufficient soldier labor to do the work.

The original specifications called for four standard types of roads, but no single type of construction was adopted in all camps and cantonments. Bituminous macadam, asphaltic concrete, brick, and cement concrete, were the four types used. The main

arteries of traffic were in general paved with brick, concrete, asphaltic concrete and bituminous macadam, the type depending on such factors as availability of materials, type of construction equipment, character of soil and speed of construction. Considering the rough usage which these roads have received, they have stood up very well; but almost constant repairs are neces-

TABLE I.

COST OF ROADS IN CAMPS AND CANTONMENTS.

(Compiled from complete data on January 1, 1919, received from the original 32 camps and cantonments.)

Type of Road.	Type of Camp.	Area of Road. Square Yards.	Length of Road. Miles.	Cost. Per Square Yard.	Cost. Per Mile.
Concrete, brick and granite block.	N.A.	667 805	62.33	$3.13	$33 600
	N.G.	243 853	21.27	2.31	31 100
	Totals and average	911 658	83.60	$3.02	$33 000
Bitulithic, bituminous concrete and bituminous macadam.	N.A.	933 366	92.53	$2.03	$20 400
	N.G.	321 813	31.37	1.70	17 400
	Totals and average	1 255 179	123.90	$1.94	$19 650
Water-bound macadam,* gravel, sand, clay.	N.A.	2 072 119	206.79	$1.40	$13 950
	N.G.	1 753 744	167.81	1.45	15 300
	Totals and average	3 825 863	374.60	$1.42	$14 500
Graded earth.	N.A.	453 200	42.90	$0.50	$5 300
	N.G.	765 544	70.97	0.49	5 300
	Totals and average	1 218 744	113.87	$0.49	$5 300
Grand totals and averages		7 211 444	695.97	$1.56	$16 200
Ditto, graded earth roads out.		6 009 100	582.10	$1.77	$18 500

* Including bituminous surfaced roads.

sary, and eternal vigilance on the part of the utilities officer is required lest the roads fall into such condition as to make their repair expensive and difficult.

In Table 1 are given the total road area and mileage in the 32 original camps and cantonments, together with the cost of construction thereof, as of December 31, 1918.

In explanation of the figures in this table it is probable that the returns for graded earth roads are incomplete as to mileage. Nevertheless the cost of some 114 miles of such roads affords a fair idea of the average cost of their construction.

Discussing generally the question of road maintenance in army camps during the first half of the fiscal year 1919, the total allotments for road repair in these 32 original camps and cantonments approximated 5½ per cent of the original construction cost. Doubling this figure gives about 11 per cent per annum, a figure certainly not excessive when due consideration is given to the intensive use to which these roads are put. Annual prewar road-maintenance cost was about 6 per cent. of the construction cost when figured on a 5-year basis, and 8 per cent. on a yearly basis. For these camp roads about $2 200 per mile is needed each year to keep them in satisfactory condition.

Building-Repair Section.

One of the chief duties of the Maintenance and Repair Branch is the care and upkeep of all buildings at regular army posts, camps, cantonments, hospitals, supply depots, terminals, etc., wherever erected in the United States and dependencies.

The buildings erected during the war emergency were of necessity constructed in great haste and of materials most available. This necessitated the use of green lumber, which is one of the principal causes of the extensive repairs which have been necessary. Another cause contributing to the rapid deterioration of these structures is the fact that it was impracticable to paint them at the time they were erected, and since that time the use of paint for this purpose has been denied. Quite naturally, unpainted buildings of this character could not be expected to withstand the effect of the elements and the extreme rough usage to which they are subjected by the occupying troops.

Constant repairing therefore has been required to keep them habitable.

In peace times sufficient money was never appropriated to keep in repair the buildings at permanent posts and stations. At the outbreak of the war extensive repairs and replacements were necessarily indicated, and such work has formed a prominent part of the duties of the Division during the past year and a half.

The building section of the utilities organization in each camp performs somewhat similar duties to those of the superintendent of buildings in a city. It is to be recalled, however, that no city building inspector has the job of maintaining hundreds of wooden buildings, and actually directing all of the repairs thereon, as is the case with the building-repair section of this Division. Their responsibilities are similar but the volume and character of work they are called upon to do differ radically.

This section looks after all repairs, prepares all estimates for construction work of a minor character, keeps account of the moneys expended from the various appropriations on each building, and in some cases handles the billeting of troops. This last function, while not universal, seems properly a part of the duties of this department, as it is always acquainted with the condition of the various buildings available for occupancy and by assigning troops to those buildings best adapted for their use avoids the necessity of altering buildings to accommodate troops, as often happens where this function of billeting is not handled by the utilities and troops are assigned to quarters according to geographical location in the camp. New construction work of a major character, involving new barracks or extensive additions to old barracks, is handled by the constructing quartermaster, who prepares estimates for submission to this office with the approval of the commanding general in each case.

It is useless to cavil over the desirability of using seasoned lumber in the construction of these buildings, since there was not nearly the necessary supply of lumber available when these buildings were put up. It is unfortunate, however, that provision was not made for painting them in the first place, as beyond all question a material sum of money would thus have been saved

and the entire general appearance of the camp would have been greatly improved thereby.

Approval of all projects and the authorization for purchase of all materials required for the making of repairs must be obtained from the executive officer of this section, at Washington, before the forces in the field can execute any work. Exception to this is the case of emergency work, not exceeding a specified amount, which may be executed on the order of the commanding general of the camp or post. A complete enumeration of the various repairs required on the variety of buildings existing in the camps and posts need not be recited here. It is sufficient to state that probably the most frequent repairs required are broken window lights, broken sash, damaged roofing, broken window screens and screen doors, broken locks, toilet tanks and seats and plumbing fixtures. The upkeep, removal and storage of the window screens and screen doors are functions of this section, as are the stove repairs and replacement of broken parts thereof. Endeavor is always made to fix the blame for any unusual damage, whether it was due to improper operation or handling, and by thus fixing the blame considerable decrease in such damage is effected. Tracing the cause of glass breakage and fixing the blame therefor has also caused a decrease in such breakage.

The minor repairs and smaller operations which are accomplished by the utilities organization in the camps are an important factor, and are of great service and saving. Small shops under competent mechanics from the enlisted personnel are maintained where such work as tinsmithing, blacksmithing, carpentry, plumbing, electrical, etc., in their various branches are undertaken. The thousand and one minor jobs that come to these shops make them active centers. Recently the utilities in many camps have opened typewriter repair shops which have proven a great saving in time and money to the various camp organizations.

Other activities of the building-repair section are the painting of all the numerical and name signs for the building and road signs in camps, the repair and rebuilding of stacks, the repair of heaters and ranges, and the care and repair of all roofs. At the

present time the last named is one of the most active departments.

The demand for roof repairs has been so great that a special study was made to determine the cheapest effective method of making such repairs, taking into account the temporary character of the buildings in other than permanent army posts. The buildings constructed since the spring of 1917 were covered with two-ply roofing paper. Due to the speed with which they were constructed, and the green lumber used in most instances, the roofing material often was none too carefully applied, and in some cases was nailed to the joists rather than to the roof decking. The drying out of this decking has caused buckling of the roofing paper, and in some cases to such an extent as to crack it or pull it around flashings, causing leaks. Much damage to the roofs has been occasioned by walking on them for signal practice, for observation posts, fire drills, etc., and some damage has been occasioned by the careless removal of snow. In coöperation with the Bureau of Standards, an economical method of roof repairing with plastic cement was adopted, and by the proper use of this material better results have been obtained and the roofs kept reasonably watertight as a cost of about ten cents per square per year.

The inspection feature of the building-repair section has been of great value in the economical maintenance of the buildings in the camps and posts throughout the country. In the camps the work is divided geographically, and constant inspection affords the prompt repair of small damage at a small expense before such defects develop into more expensive repairs. In cases of great damage, or where the request is made upon Washington for authority to execute work which appears to be excessive, inspection is made by a special officer sent out for the purpose, and by such inspection cases can be cited where thousands of dollars have been saved, due to the special technical knowledge of the inspector who was able to advise those in the field of more economical means of securing the same or better results than by the method contemplated in their request. A typical instance is that of a hospital building which had been leased by the Government under contract requiring the Government to make

all repairs. The operating engineer on this building for the private owners was taken over by the Government to act in the same capacity. Although a new roof had already been put on the building, complaint was made to Washington that it was in leaky condition, and that a new roof should be put on. The inspector sent from this office found that at an expense of twenty-five dollars the roof could be put in first-class condition, thus saving the expense of the requested new roof, which would have amounted to approximately $3 500.

Table 2 shows the total number of buildings in the several camps and cantonments and the average number of each class of buildings per camp; in the 32 original camps and cantonments, including remount stations and base hospitals, there are 51 927 buildings. In the national army and guard camps the average number of buildings per camp is 1 731 and 1 511, respectively.

The annual cost of maintenance and repair of buildings (Table 3), based on the figures for the six-month period ending December 31, 1918, and exclusive of any charge for soldier labor, amounts to the following per capita of camp population:

Roofing	$0.32
Screening	0.08
Carpentering	5.94
Miscellaneous	1.76
Total	$8.10

Commenting briefly on the maintenance cost of buildings in these camps and cantonments, it may be remarked that the cost of building construction was approximately $100 per capita. The maintenance cost for the first year was 8.1 per cent., or about double the United States standard for pre-war maintenance of buildings of this type (Tiffany's estimate). In view of the increased cost of materials due to war conditions, the haste with which these buildings were put together, the character of the timber of which they were built, their lack of protective paint and the rough use they have had, the annual maintenance cost to date of some 8 per cent. is low. In fact, we have estimated that for the current year, in the light of material alterations and abnormal repairs which are necessary in the contonment, supply depot and terminal buildings, an expense equal to about

$25 000 000 will be incurred. Nearly half of this will be required to put in condition the storage depots, where the contents require adequate protection. The storage warehouses alone cover an area of 42 500 000 square feet.

TABLE 2.

NUMBER OF BUILDINGS IN CAMPS AND CANTONMENTS.

National Guard Camps (16).

	Total Number.	Average per Camp.
Barracks	29	2
Mess and barracks	5 575	344
Latrines and showers	10,696	669
Guardhouses	20	1
Infirmaries	176	11
Garages	58	4
Administration	95	6
Magazines	79	5
Stables	3 198	200
Storehouses, etc.	1 183	74
Total	21 109	1 316
Remount stations	1 037	65
Base hospitals	2 081	130
Grand total	24 227	1 511

Average size, 1 632 sq. ft.; 20 290 cu. ft.

National Army Camps (16).

Officers' quarters	2 012	126
Barracks and mess	4 338	271
Barracks, no mess	2 254	141
Mess buildings	331	21
Guardhouses	874	55
Infirmaries	266	17
Administration	455	28
Lavatories	7 730	483
Bakeries, firehouses, garages, shops, etc.	647	40
Storehouses, sheds, stables	6 604	413
Camp activities	306	19
Total	25 817	1 614
Remount depot	859	53
Base hospitals	1 024	64
Grand total	27 700	1 731

Average size, 2 725 sq. ft.; 40 280 cu. ft.

TABLE 3.

NUMBER, AREA AND CUBICAL CONTENTS OF CANTONMENT BUILDINGS AND COST OF MAINTENANCE AND REPAIR.

	No. of Buildings.	Area, Sq. Ft.	Volume, Cu. Ft.
N. G. camps (16)...............	21 109	27 599 799	329 997 586
N. A. camps (16)...............	25 817	64 155 154	962 327 300
Embarkation and Quartermaster-training camps (5)...........	2 612	5 364 179	80 462 682
Remounts (37).................	1 956	12 166 117	145 993 407
Base hospitals (21)..............	3 316	12 455 940	186 839 100
Totals.....................	54 810	121 741 189	1705 620 075

Expenditures for Maintenance of Buildings for six months, July 1 to December 31, 1918.

N. G. camps,	$26 361.52	$ 6 590.38	$483 733.89	$142 352.48	$ 659 038.27
N. A. camps,	41 189.84	10 297.46	755 833.56	222 425.90	1 029 746.76
Embarkation,	47 323.00	12 735.75	865 372.62	255 843.70	1 170 575.01
Hospitals....	47 472.96	11 868.24	871 128.80	257 353.98	1 186 824.00
Totals.....	$162 347.32	$41 491.83	$2 976 068.87	$877 976.06	$4 046 184.04

Average cost of maintenance and repair was 0.24 cent per cubic foot. The total population quartered averaged approximately 1 000 000. On this basis the cost of maintenance and repair of buildings for six months' period, ending December 31, 1918, was $4.05 per capita, or $8.10 per annum.

FIRE PROTECTION.

Fire protection in the large groups of highly inflammable wooden buildings comprising the army cantonments is a matter of vital importance. The inherent potential fire hazard was recognized in the design of the camps, and "fire breaks," or wide open spaces, were interspersed at suitable intervals, and the individual separation of buildings was given due consideration. This policy has been amply justified and undoubtedly has influenced the result that up to the present time there have been few instances where fire originating in one building has spread to another.

The distribution of first-aid fire-extinguishing appliances in sufficient number in all buildings is general, these consisting of water pails, hand-pump tanks, and fire extinguishers of the $2\frac{1}{2}$-gal. and the 1-qt. type. Buildings of the hospital units and

warehouses generally have automatic fire-alarm systems, designed to give prompt notification of fires in such structures.

In each of the camps and cantonments, a fire truck and hose company has been organized. The strength of this company is about sixty men, composed chiefly of men who have had training as firemen in municipal fire departments. It is commanded by an officer with similar experience. This company is divided into sections, stationed in the several fire stations distributed about the camp. The fire companies are provided with standard fire engines and hose wagons of the municipal type, and with three or four small triple combination Howe-Ford pumping engines. Due to rough roads and the demands in bad weather conditions, these light engines have suffered quite badly, and their replacement with the heavier types of fire apparatus has followed in numerous instances.

Of course, it is vitally essential that the water supply for fire protection throughout the camp be satisfactorily maintained, and that the water, storage and pumping facilities be ample to supply these needs. In the original construction, provision was made to deliver on three minutes' notice twice the average water demand in order adequately to meet peak loads and fire-protection requirements. As an additional precaution in connection with the water supply, there is installed in all pumping stations duplicate equipment of power-generating and pumping machinery. Electric power is used to drive the units in regular operation, and the reserve units have gasoline-driven motors. These latter units are operated at frequent intervals each week, to keep them in order and in readiness for quick service.

Stringent fire regulations have been issued by the fire marshal at each of the camps and cantonments, and he is held directly responsible for their enforcement in every particular. Members of the Fire-Prevention Detachment of the fire-service personnel make periodic inspections of barracks, remount depots, storehouses, etc., reporting any dangerous accumulation of rubbish or other material violation of the fire regulations; and such violations are eliminated as promptly as possible. The hospitals call for safeguarding to a particular degree, since so many of their inmates are unable to protect themselves. In

addition to protection against fire, unusual precaution was adopted to prevent loss of life in the event of fire occurring.

The fire loss per capita has been kept down to a remarkably low figure, considering the character of the building construction in the camps. The total fire loss in army camps and cantonments, with average populations of about 30 000 during the year 1918, amounted to 46 cents per capita as against a fire loss of $2.10 per capita throughout the United States. This is noteworthy, in view of the fact that the standards of the National Board of Fire Underwriters designate as low the per capita loss in municipalities when it is less than $2.00 per annum. Thousands of fires started, but only four got beyond the building in which they originated, and in each case the cantonment fire department succeeded in saving a part of the building to which it spread.

It is indicative of the zeal and devotion to duty of the men concerned in the fire-protection and fire-prevention work that the number of fires and the resulting fire losses have been so small. There is evidence also of the unity of effort of the various utilities of camp activity to bring about this reduction of the fire loss. The upkeep of roads to facilitate quick response of fire apparatus; the proper maintenance of telephone, manual and automatic fire-alarm systems, permitting prompt notification of fires; due care in the heating and lighting hazard; and the well-directed operation of the water supply for fire protection, — all of these are contributing features worthy of mention as bearing on the safety of the camp from damage or destruction by fire.

Electrical Section.

In view of the great volume of construction work done in 1917 and the speed with which it was produced, it is not at all surprising that some mistakes were made in the electrical equipment or that some materials were more than liberally used. The camp utilities officers were instructed to bear this in mind and promptly correct any defects wherever possible. Minor defects of design and construction were readily corrected in conjunction with the daily operation and maintenance of electrical systems.

The entire electric service, from the approval of electrical contracts, where energy is purchased, to the ultimate use at the

lamps, motors or other energy-consuming devices, is operated and maintained by the Maintenance and Repair Branch. Such contracts are an index to valuable information leading to the elimination of waste and excessive costs. One of the first major efforts of this Section was a careful analysis of all important contracts for electrical energy. This analysis developed the fact that costs in some instances were excessive and unwarranted, and immediate steps were taken to secure more favorable rates.

A typical example was that at Camp Sheridan, where the contract price was 5 cents per kw. hr. for the first 50 000 kw. hrs., and all energy in excess of that amount during any current month was 4 cents. At the close of the fiscal year 1918 (June 30, 1918), bids were requested from the two central station companies available for rendering service after a physical examination of their respective properties had been made. It was therein definitely determined that each company was capable of supplying adequate and satisfactory service. The final result of this investigation was a revamping of the contract and rates, followed by better service and a reduction in rates to $1\frac{1}{2}$ cents per kw. hr. In this single instance a saving of from $30 000 to $40 000 annually was effected, depending upon the number of troops stationed at this camp.

A typical case involving slight changes and adjustment in generating equipment occurred at Fort Hancock, N. J. A request for funds in the amount of $600 was made for the purpose of installing additional governing equipment on two engine-driven generating units. Investigation by this office developed the fact that no two of the several units could be synchronized and operated in parallel. Alterations of the wiring of the generators and exciters together with other minor changes, costing less than $25, provided the remedy. This is but one of scores of similar cases rooted out by the Maintenance and Repair Division. The individual savings are not great, but collectively show figures of importance.

The routine duties of the utilities officer in the field consist in seeing to it that the necessary generating capacity is available at the power station, that the transmission lines are of sufficient size and number and properly protected, and that the necessary

transformers and service stations are of a sufficient capacity adequately to meet the demands and to properly distribute this energy where it is needed. The secondary distribution circuits, all interior wiring in buildings, together with supplying and maintaining in all camps the electrical power equipment of the pumping stations, the refrigeration plants, laundries, etc., fall within the duties of the utilities organization.

Complete operating records are kept so that it is possible to check the energy consumption and thus eliminate extravagance and wasteful use.

General comments of passing interest may include the statement that in the camps and cantonments the amount of electric wiring totals about 1 000 000 ft., or 190 miles, in each case. At Camp Funston there are 1 320 000 ft., or 250 miles of electric wiring, with 34 900 outlets.

The consumption of electric energy varies according to the geographical location of the camp, and to local variables such as transmission distances, pumping, etc., which are not the same in any two camps. Generally speaking, however, the average per capita consumption in all the camps is about 7.5 kw. hrs. per month, ranging from about 5.0 kw. hrs. in the summer to about 10.0 kw. hrs. in the winter.

The cost of electric current varies, of course, due largely to local conditions. At Camp Lewis, with water-power generation, it costs about \$0.009 per kw. hr., while at Camp Mills, with steam generation and under somewhat unusual conditions, it costs about \$0.075 per kw. hr. On the average, however, the cost of electric energy in the camps is 2.57 cents per kw. hr.

These figures give an annual per capita cost of \$2.475 for electric energy used in the camps for all purposes. The cost of operation, maintenance and repair of substations, power stations, transmission, distribution and service lines, lamp, replacements and interior wiring and fixtures, averages about \$5.50 per capita. The average total cost of electric service in the camps, therefore, is about \$8.00 per capita per annum.

In making up the annual estimates, a substantial charge is indicated for electric current at the storage supply depots. Lighting must be furnished for interior and for platforms and road-

TABLE 4.

ELECTRIC ENERGY CONSUMPTION.

(July to December, 1918, inclusive.)

Camp.	Average Population.	Cost of Energy per Kw. Hr.	Kw. Hr. per Capita.	Cost per Capita.
National Army Camps.				
Custer	33 326	.0154	53.4	$0.822
Dix	43 561	.0283	32.1	0.909
Dodge	32 097	.0280	50.0	1.400
Funston	41 389	.0389	44.2	1.719
Gordon	33 547	.0186	33.0	0.350
Grant	36 475	.0271	59.7	1.618
Jackson	38 691	.0250	37.3	0.931
Lee	46 512	.0174	48.6	0.847
Lewis	33 223	.0091	72.3	0.656
Meade	42 352	.0325	54.5	1.771
Pike	42 700	.0157	49.5	0.777
Sherman	30 326	.0531	71.7	3.773
Taylor	41 415	.0250	35.4	0.886
Travis	31 675	.0314	30.6	0.961
Upton	31 920	.0307	62.4	1.915
Total	559 199			
Average		.0259	48.4	$1.255
National Guard Camps.				
Beauregard	12 215	.0200	53.8	$1.075
Bowie	8 045	.0315	38.6	1.111
Fremont	17 021	.0200	21.9	0.438
Greene	13 758	.0150	35.1	0.524
Hancock	31 785	.0154	21.3	0.329
Kearney	16 906	.0275	38.0	1.046
Logan	13 243	.0234	38.0	0.887
McArthur	21 319	.0261	33.8	0.881
McClellan	25 346	.0287	30.6	0.864
Sevier	20 707	.0150	31.1	0.456
Shelby	15 511	.0300	65.9	1.975
Sheridan	20 374	.0150	23.5	0.353
Ft. Sill	16 897		40.5	
Wadsworth	19 095	.0162	35.6	0.577
Total	270 047			
Average		.0220	31.9	$0.692
Other Army Camps.				
Humphreys	23 395	.0316	37.5	$1.301
Johnston	20 467	.0154	36.2	0.558
Merritt	19 969	.0305	53.4	1.616
Mills	18 369	.0750	7.1	0.422
Stuart	7 536	.0500	66.9	3.344
Total	89 736			
Average		.0322	34.6	$1.113
Total all camps,	918 982			
Average, all camps		.0257	42.2	$1.082

ways. The maintenance charge is less than in camps. A total cost for electric current at storage depots for the year is figured at about $4 760 000.

Table 4 shows the consumption and cost of electric current consumed in the camps and cantonments for the six months ending December, 1918.

Steam Heating.

The steam-heating plants, both central and isolated, together with the hot-water systems in camps and cantonments, are under the jurisdiction of the Maintenance and Repair Branch. These plants must be maintained at a high standard of efficiency, not only for the continuity of service, but for the comfort of every one, particularly patients in hospitals. In a number of the camps one large heating unit supplies the base hospital, and from 100 to 175 individual steam-heating plants, barracks, officers' quarters, mess halls, etc. All gas mains and gas service, together with the piping and plants for using gas, are maintained by this Division.

In connection with heating operations, the conservation of fuel is of great importance. Last summer the Fuel Administration advised that the country must save 50 000 000 tons of coal during the year. A scrutiny of the records of this Division shows that at 14 central heating plants a saving of almost 50 per cent. of the estimated coal requirements was effected by careful operation alone. The figures from which this result was computed were taken from actual consumption records from the middle of October, 1917, to the middle of May, this year. The estimated daily average coal required was 360 tons. The actual consumption was 179 tons, less than half the estimated requirement. These figures were taken from a Northern camp, where the coal cost was $8.21, delivered at the boiler house, and the saving effected over the estimated requirements amounted in money to $313 213.

The repairs to these heating plants can run into large figures unless the equipment is properly cared for and carefully watched and minor repairs made before they develop into major instances. In the 14 central plants above referred to, the manual repairs

amounted to considerably less than 20 per cent. of the total cost of equipment. Of this amount fully 90 per cent. was due to forced construction, such as erection of boilers and settings at base hospitals in rainy weather, and which, through necessity, had to be put in operation at once, causing the boiler settings to crack in some cases.

Something over 5 000 000 sq. ft. of cast-iron radiation is used for radiation in the cantonments alone. Camp Funston has 617 000 sq. ft. of radiation. Tens of thousands of room heaters and stoves are used, and all these have to be kept in good order by the Maintenance and Repair Division.

Refinements in the equipment of boiler houses, such as scale, water meters, gas analyses, thermometers, etc., have put the operation of Government boilers on an equal footing with high-grade commercial enterprises. Smoke from soft coal has been minimized through the use of graduated smoke screens in the hands of inspectors who rate boiler houses as to their output.

With all care exercised in its use the amount of coal consumed in the camps and cantonments (Table 5) reaches the large total of nearly 2 000 000 tons annually. The average cost of this coal was $5.03 per ton, delivered at the camps, the amount used 1.99 tons per capita per year, involving an average cost of $10.01 per capita annually.

Approximately 30 per cent. of the total coal consumed was used to heat the camps. This amounts to about 0.6 ton per capita as an average for all camps, and an average cost of $3.02 per capita per year. During the extreme cold weather of last winter Camp Funston used 8 640 tons of coal per month for heating purposes, and to heat the 2 000-bed base hospital at Camp Dix during November, 1918, required 1 271 tons.

Fuel cost is not a particular concern of this Division, however. The operation, maintenance and repair of heating plants, heaters, etc., are a function of this Division. All this equipment has greatly deteriorated, extensive replacements of boiler settings, boilers and heaters are required, and from the data available from the records of last year it is estimated that for all this work for the current year the average cost will be $9 per capita.

To heat the some 30 per cent. of the 595 000 000 cu. ft. of

storage space in the supply depots, where the one-story buildings are only sheeted and paper-roofed, furnishes a material item of expense. Under the construction circumstances just mentioned it is figured the cost for low, steady heat will be 1.5 cents per cubic foot, representing a total cost for heating warehouses of $2 677 000 per annum.

Refrigeration.

In addition to refrigerating and ice-making equipment installed in a large number of regular army posts, there are installed, in various camps and cantonments, 31 cold-storage plants for the preservation of beef and other perishable products. Nineteen of these plants have ice-making equipment installed in conjunction with the refrigerating equipment. No ice-making equipment was installed at localities offering facilities sufficient to supply camp needs at a reasonable price. No cold-storage plants were installed at camps where such space was available at a reasonable price, and at a location sufficiently close to camp to insure satisfactory service.

The operation, maintenance and repair of all refrigerating equipment comes within the jurisdiction of the Maintenance and Repair Branch. To insure maximum production and minimum cost of operation, a complete method of recording and reporting operating data has been installed.

The temperature required in cold-storage rooms must be such as to satisfy the various subsistence officers. No report has been received of failure to maintain satisfactory temperatures, and in no instance has there been a spoilage of perishables traceable to a failure in refrigeration.

Prior to the installation of refrigeration plants it was necessary to keep perishable products in the refrigerator cars in which they were received. This frequently necessitated demurrage with a restriction of the available rolling stock. Since plants have been installed no reports have been received of cars having been held over the allowed time for unloading.

Ice for issue to detachments has been produced at all times where plants are installed. In several camps where the strength of the command has been much larger than originally planned

TABLE 5.

COAL CONSUMPTION IN CAMPS.

(Per annum.)

Camps.	Population.*	Tons of Coal. Bituminous.	Anthracite.	Total.
Beauregard	15 387	3 325		3 325
Bowie	6 573	4 632		4 632
Cody	21 200	13 085		13 085
Custer	29 200	154 277		154 277
Devens	35 460	23 000	65 050	118 050
Dix	38 795	20 270	56 000	76 270
Dodge	29 758	97 000		97 000
Eustis		27 000		27 000
Fremont	20 265	7 557		7 557
Funston	32 800	118 700		118 700
Gordon	35 815	30 000		30 000
Grant	33 500	228 000		228 000
Greene	24 000	31 603		31 603
Hancock	28 234	44 000		44 000
Humphreys	22 500	111 536		111 536
Jackson	32 701	39 090		39 090
Johnston	18 600	3 170		3 170
Kearney	19 931			
Lee	39 650	55 750		55 750
Lewis	34 150	69 700		69 700
Logan	19 220	3 600		3 600
McArthur	22 450	4 794		4 794
Meade	36 717	26 300		26 300
McClellan	27 200	18 953		18 953
Merritt	18 300	12 200		12 200
Mills		3 280		3 280
Pike	37 900	71 335		71 335
Sevier	21 000	41 940		41 940
Shelby	22 943	15 760		15 760
Sheridan	19 550	44 060		44 060
Sherman	33 000	97 500		97 500
Sill		22 748		22 748
Stuart				
Taylor	35 200	100 000		100 000
Travis	31 800	16 322		16 322
Upton	33 988	4 800	57 750	62 500
Wadsworth	25 100	35 090		35 090
Wheeler	20 793	42 140		42 140
Totals	1 000 000†	1 642 517	349 255	1 991 772
Total cost		$7 391 327	$2 619 413	$10 010 740
Cost per ton		$4.50	$7.50	$5.03
Cost per capita		7.39	2.62	10.01

* Average daily January–October, 1918, inclusive.

† Adding 58 219 for Eustis, Sill and Stuart.

for (in some instances nearly doubled), it was necessary to purchase ice locally during the excessive heat of last July and August.

Consumption of ice, during August, 1918, at 28 camps, is shown in Table 6, in which the camps are grouped relative to the mean summer temperature of their locality.

TABLE 6.

ICE CONSUMPTION IN CAMPS.

Mean summer temperature at camp location	55–60	60–65	65–70	70–75
Number of camps within limits included in average	2	9	13	4
Total tons of ice consumed during August, 1918	829.69	7 162.4	12 229.75	5 243
Average total population of camps	67 000	327 000	336 000	80 000
Maximum consumption, lbs. per capita per day	0.83	3.18	4.69	5.51
Minimum consumption, lbs. per capita per day	0.75	1.08	1.04	3.43
Average consumption, lbs. per capita per day	0.8	1.42	2.35	4.23

Difficulty was at first experienced in securing trained personnel for the operation of the refrigerating plants. By proper selection and training it has been possible to produce competent operators, who are now handling the equipments with a marked degree of economy and efficiency. The records of these plants show that they are being operated on a basis entirely comparable with the best commercial installation of their respective types.

Data on refrigeration secured by this Branch clearly show that the ice supply at various camps may fairly be stipulated according to the geographic location, as shown on map, Manual Q. M. C., Appendix 2044, as follows:

North of isotherm 60 degrees, 1 lb. per capita per day.
Between isotherms 60–65 degrees, 1½ lbs. per capita per day.
Between isotherms 65–70 degrees, 2½ lbs. per capita per day.
South of isotherm 70 degrees, 4½ lbs. per capita per day.

To summarize, it appears from the complete data available from 28 camps and cantonments, ice consumption for refrigeration and issue purposes ranges from 0.2 to 6 lbs., and averages 1 lb. per man, or 0.18 ton per capita annually. At $5 per ton this amounts to $0.90 per man per year. To operate and maintain these refrigerating plants and systems costs about $2 per capita annually, which figure includes all charges except labor.

For the three supply depots wherein perishables are stored,— the largest of these being the Chicago Storage Depot, — a total cost for refrigeration of $280 800 per annum is indicated.

Water Supply.

The water supply was one of the most important items to be considered in the selection of a camp site. When necessity arose of constructing on short notice the original 32 camps, there was no time for extensive investigations of the various sites offered to the Government with respect to their comparative advantages as to topography, transportation, drainage, etc. It was fully appreciated, however, that the water supply must be sufficient to meet all reasonable needs and that the sanitary quality must be beyond question. Engineers experienced in water-works planning were sent to investigate the proposed supply for each camp and report to the Cantonment Division before the location was finally approved.

The original program provided for 16 national army camps having all modern improvements, such as good roads, electric lights, water works and sewerage. Each camp was to be built to accommodate a given population in most cases between 35 000 and 45 000. The advisory engineers associated with the Cantonment Division in preparing general policies and typical plans decided that an allowance of 55 gals. per capita was sufficient for all reasonable uses. A maximum rate of 2.85 times the average rate of consumption was assumed for peak load and fire periods. On the basis of these figures the planning engineers could arrange for supplies from adjoining municipalities or for the Government to develop its own supply.

Soon after sites for the 16 major camps had been selected it was decided to build 16 National Guard camps. These were

intended only for temporary use. Instead of wood barracks the troops were to be quartered under canvas. Sewerage was not contemplated. The water-works systems consisted for the most part of wrought iron and steel piping, the main lines being generally 6 ins. in size. Under these conditions a low per-capita consumption (about 25 gals. per capita) was figured on, and the water works were planned accordingly. In the spring of 1918, when it was decided to change the tent camps into permanent camps, it became necessary to reinforce the water-distribution systems in order to take care of the increased consumption caused by the installation of sewerage and sanitary plumbing fixtures.

To meet the Government requirements it was necessary in a number of cases to install additional filter units, new pumping machinery and force mains in the case of purchased municipal supplies. The contract called for a certain daily quantity of water per day and a maximum rate of delivery at any hour of the day or night. This was due to a higher per-capita consumption at first and also to the enlargement of some of the camps beyond the originally authorized personnel. At the same time it must be remembered that there was a considerable increase in the city consumption due to the increase in population incident to the establishment of the camp. These two factors resulted in the municipal plants being taxed to their highest capacity and in some cases being seriously overloaded. The remedy was water conservation, of course, and an energetic campaign was inaugurated to reduce underground leakage and waste to a minimum. The gratifying results along this line are recorded elsewhere.

That the water supply has been of the best sanitary quality is evidenced by the health records. Since the establishment of the camps there has not been a single typhoid outbreak attributable to the water supply. It is true, of course, that general vaccine treatment affords protection. However, past experience has demonstrated that the failure of an inoculation to prevent typhoid is more than merely measureable. During the summer months of 1918 the total population in all the camps was approximately 1 000 000, of whom 2 000 can be assumed as being susceptible to typhoid, in spite of vaccination. Furthermore,

the combined population in the cities using the same supplies was much larger than the military population of the camps, and universal anti-typhoid inoculation was not followed therein. So far as the records show, there was no serious water-borne outbreak in these cities during the past year. The records are clear for the 15 camps which developed their own supplies. The combined average daily population of these was approximately 400 000, of whom easily 800 were susceptible to typhoid. The records show not a single case of typhoid attributable to the water. Each of the water-works plants was operated entirely by the utilities organization which was directly responsible for the service rendered and the sanitary quality of the water furnished.

Credit must be given to other organizations and agencies for checking up the sanitary quality of the water by means of bacteriological examinations. The larger cities maintain laboratories either at the water-works plant or in the office of the city health department. The U. S. Public Health Service, responsible for the general health conditions in the cantonment zones, also made laboratory examinations of the water either daily or several times each week. In the camps analyses were made more or less regularly at the base hospitals. With these three separate agencies checking up the supply, any deterioration in quality was certain to be discovered.

The Maintenance and Repair Branch is responsible for the delivery to each camp of an adequate quantity of pure water at all times. All matters of location are under the supervision of the Washington office, which keeps in touch with the local conditions by means of inspections and through the reports and communications submitted by the camp utilities officers.

At each camp there is an officer in charge of water and sewers, acting under the orders of the utilities officer. These men were selected from positions in civil life in themselves a guaranty of their ability. In detailing these officers to camps, due consideration was given to local conditions; for example, a man with the experience in filter operation was sent to a camp having a filter plant, or using a filtered supply from the municipality.

The utilities officer was instructed as to the importance of keeping in close touch with the municipal water-works plant and thereby exercise supervision over it. Local authorities have been made to understand that the Government is as much interested in the operation of the water-works plant as the municipality itself. The result has been that the utilities organization in safeguarding the supply for the camp has at the same time safeguarded the water used at all these municipalities.

The camp utilities officer is required to submit at the end of each month a report showing in detail the operation of the filtration plant. The amount of water filtered, the number of filters in use, the quantity of chemical used, the results of tests, etc., are recorded. These are carefully studied, and attention promptly called to any defects in the operating program.

It is gratifying to record that city authorities have in almost every instance given the fullest coöperation in providing facilities so that the plant could give as good service as possible under the existing conditions, and also accepting the suggestions of the utilities organization with respect to submitting records, reports and other information.

As to the cost of water, a study of the records shows that of all the camps 22 were furnished water by contract at an average rate of $8\frac{1}{2}$ cents per 1 000 gals., the prices ranging from 4 cents at Camp Doniphan, to $17\frac{1}{2}$ cents at Camp Fremont. With an average total daily population in these camps of 520 304 (January to October, 1918, inclusive), and a total consumption daily of 25.3 million gallons, the total daily cost amounted to \$2 153.52 per day, or \$1.51 per capita per year, for an average of 48.6 gals. per capita daily.

The average cost of $8\frac{1}{2}$ cents per 1 000 gals., considering the high cost of chemicals, coal, etc., and labor, appears very reasonable. It is not at all impossible that the actual cost of production was somewhat in excess of the rate charged.

The contracts were made hurriedly, when there was more or less competition on the part of municipal authorities to secure the location of the camps. Notwithstanding these conditions, requests for increase in rates after the contracts were executed were made in only two instances, namely, by the Arkansas

Water Company which supplies Camp Pike, and by the City of Greenville which supplies Camp Sevier. An investigation of the former case indicated that, under the conditions water was being furnished, a higher rate was justifiable. The matter was finally arranged to the satisfaction of the company by the Government agreeing to finance and also assume a part of the cost of needed additions in the plant owned by the company.

The rate at Camp Sevier was raised from 8 cents to 10 cents per thousand gallons, beginning January 1, 1919. It is also to be noted that the per capita yearly rate of 65 cents at Camp Sevier is the lowest of all the camps. In view of this and of the fact that the city had spent about $150 000 for a filtration plant and other improvements to furnish the Government with water, it was decided that the request for a higher rate was just and proper, and it was accordingly granted.

The total cost per year for purchased water for the camps listed is a little over $785 540. To this must be added the expense of pumping by the Government and maintenance of pumping station, pipe lines, storage tanks, etc. In this connection it must be understood that the purchased water was delivered into the elevated reservoir at the camps in only a few cases. Usually the supply is delivered into a low-level reservoir or at a low pressure, and has to be re-pumped. At Camps Pike, Kearney and Forrest, the Government maintains a booster station on the force main, in addition to the station in the camp. Hence there is an additional item of expense. Although detailed figures have not yet been submitted, it is believed that 2½ cents per thousand gallons for this item is not far from correct. This would make a total cost of $1 015 830, and a per capita yearly cost of $1.95 for these 22 camps, with a total average population of 520 304.

In addition to this figure there is to be added the cost of repairs and replacements. In the case of much of the overworked machinery, this charge will be abnormally high during the current year. These and similar charges for reservoirs, tanks, pipe lines and plumbing fixtures are estimated from the data on hand, at $2.50 per capita per annum, making a total cost for water of $4.45 per capita per annum, or 25.7 cents per 1 000 gals. This is a fair average figure for all camps.

Water Conservation.

Water consumption in national army cantonments during the first months of their occupancy by troops was, in the large majority of cases, exceeding the 55 gals. per capita allowance, on which the plans for the water supply of these camps were based.

When these facts were realized, and the water conservation problem was first considered, it was thought that the elimination of water waste would be a comparatively simple problem. The fact that the consumers of water were all subject to military discipline suggested the thought that if orders were issued restricting the use of water, the effect of these consumers would make itself evident by a reduction in the water consumption. That more energetic steps were required other than issuing printed orders was evident from the first inspection made.

On the first inspection the impression gained was that large quantities of water were being lost through defective plumbing fixtures. Ball cocks on flush tanks were leaking in approximately 50 per cent. of the latrines inspected. A large percentage of shower heads were also in leaky condition.

It was decided that constant and systematic inspection and repair was the only effective method of correcting these defects. The installation of round-head, self-closing faucets was seriously considered, but it was finally decided that the saving effected would not warrant the expenditure of scrapping and replacement of the present equipment. There is no question, however, that the additional cost of self-closing faucets and mechanical flushing devices on toilets would have been justified had these fixtures been available when the original construction plans were made. Self-closing faucets were authorized for all new camps and additions to camps which were building at the time construction activities ceased.

In the month of January, 1919, when the peak per-capita consumption was reached, Camp Grant reported the maximum average per-capita consumption for the month of 123 gals., while Camp Taylor reported the minimum average of 42 gals. The grand average for all national army cantonments for the month

of January was 72.7 gals. per capita. The high consumption for the winter months may be attributed, to some extent, to running water to prevent freezing and to central heating plants, without return systems.

Inasmuch as the water supply was in most cases designed on a 55-gal. per capita basis it was realized that some means must be taken to reduce the water consumption, or the systems as they were designed would prove inadequate to meet the heavy draught that always occurs during the summer months, leaving no reserve for fire protection, compulsory shutdowns, etc.

The continued reduction in per-capita consumption is evidence of the effects of the campaign against water waste. From January to May the reduction in per-capita consumption was 11.7 gals. The reports for the month of June show that the consumption was increasing to meet the increased demands of the summer months. The average per-capita consumption for that month was 62.7 gals. per day.

The majority of the national army cantonments have wood-stave pipe for their distribution mains, some 3 500 000 ft. in all having been laid in the national army and national guard camps. The camp systems as a whole are thus probably the largest water-distribution installations that have been made using wood-stave pipe.

Careful investigation revealed that, in addition to such underground leakage as might exist, there were large quantities of water being lost through careless use and defective plumbing fixtures. For this reason it was felt that efforts to reduce the consumption by controlling the waste in fixtures and careless use would be productive of better results in less time and with less labor than to center major efforts on elimination of the underground leakage.

Posters were printed urging the men to conserve water. A plan to prosecute a vigorous plumbing inspection and repair campaign was developed and put in operation, the results of which were at once apparent, the per-capita consumption for July dropping to 60.5 gals.

Considerable ingenuity was displayed by some utilities organizations in combating the useless waste of water. In some

camps the dangerous practice of partially closing valves on the main line to reduce pressure was being resorted to. The practice was forbidden when it was discovered that such means had been employed. What proved to be the most successful means of reducing waste was the use of some sort of device in each faucet and shower head to reduce the rate of delivery of these fixtures.

This method of local pressure reduction was followed in many camps with as many variations in applications as there were camps. One inserted a piece of $\frac{1}{8}$-in. tubing back of the faucet, another a tin button with two thread holes; still another a glass marble; while the most popular device was a tapered lead plug with $\frac{1}{16}$-in. to 3/32-in. orifices, the size depending on the pressure. The latter proved an inexpensive and easily installed device.

It was also suggested that the lowering of float balls in flush tanks on toilets would be productive of a large saving. This plan has also been adopted in most camps.

The continued reduction of water consumption throughout the summer months, when a peak consumption is ordinarily to be expected, proved that large quantities of water were being lost through useless waste and defective fixtures.

August showed a further reduction, with an average of 54.9 gals. per capita per day, while September results showed that the average was well within the maximum allowance with an average per-capita consumption for all cantonments of 49.5 gals. per day.

The possibility of underground leakage had not been entirely overlooked. Water surveys for the location of underground leakage were made at Camps Dix, Grant, Meade, Lee, Dodge and elsewhere. The results obtained in the above-named camps did not indicate that large quantities of water were being lost through underground leaks as was supposed. The high night rate naturally led to the belief that a large portion of this water was being lost through underground leaks.

At Camp Dix there are approximately 19 miles of water main, one third of which is cast iron with leadite joints. There is approximately 25 miles of service pipe ranging in size from 3-in. to $\frac{3}{4}$-in., and about 15 000 water fixtures. By careful test it

was determined that fixtures, waste and legitimate use accounted for 400 000 gals. of minimum night rate of 600 000 gals. per twenty-four hours. It was also determined that the filling of the railroad water tank accounted for another 100 000 gals. This was previously attributed to underground leakage.

At Camp Grant a total of 48 840 ft. of main and 55 900 ft. of service pipe, after a careful test, showed a total underground leakage of 35 588 gals. per twenty-four hours. One third of the minimum night flow at Camp Meade has been located in three sections of camp; the remainder has been accounted for as legitimate consumption and fixture leakage.

Equipment was ordered and shipped to 25 camps where relatively high-water consumption persisted, and searching water surveys thenceforth became one of the important duties of utilities organizations in the camps.

Sewerage.

The construction of 384 miles of sanitary sewers for the 16 national army camps, and approximately 80 miles for the national guard camps, was an undertaking of no small magnitude. General instructions in regard to minimum gradients, maximum flows for regimental units, and methods of construction were issued for the guidance of the consulting engineers at the various camps. In this connection it should be remembered that at that time there were practically no data available concerning sewage flows from large army camps in this country, and there was the unknown factor relative to future extension of the camps. Experience has shown, however, that the sizes specified in the original instructions are entirely adequate.

During the fifteen months the sewer systems have been in operation very few defects have developed, a rather remarkable fact considering the haste and other unusual conditions under which they were installed. In most instances locations had to be selected and grade lines run long before the completion of the topographical maps and before the system as a whole had been put on paper. In construction the same degree of inspection and rigid enforcement of specifications such as obtain in municipal practice was not to be expected. The systems had to be com-

pleted as soon as the camp buildings were ready for occupancy, and engineering refinements had to be discarded.

Sewer sizes range from 6 ins. up to 24 ins., and in a few cases 30-in. outfall lines. Manholes were designed to be built as cheaply as possible, and were provided with wood covers. During the past summer most of these covers have been equipped with locks in order to prevent the throwing of garbage or refuse into them.

Every effort is made to prevent the access of surface water and the infiltration of ground water, particularly at camps having sewage-treatment plants. Utilities officers were instructed to watch for any indication of surface water during periods of rain, and to use every effort in locating any defective sections. Investigations of a number of camps showed that in the haste of construction the manhole tops had not been made high enough and that surface water was gaining access to the system. Orders were issued that all such manhole tops should be raised.

At a few camps trouble was experienced with sand, which found its way into the system through such low manholes as mentioned above, and partially filled up the first compartments of the septic tanks. In one or two instances the trouble was due to defective sections of sewer which had to be relaid.

In the few instances where clogging of sewers has been reported, grease has usually been the cause. The policy in regard to grease traps and their operation is discussed elsewhere.

In regard to peak flows which reached the sewage works, the variations depend a great deal on the shape of the camp. Large numbers of shower baths and lavatories are used at the same time. To illustrate, assuming that the buildings are arranged in a straight line, it will be seen that the flow from one building will follow the flow from the building in front and so on. In other words, the flow will be in a series of waves with no concentrated peak. Then assume an extreme case where buildings are located on the circumference of a half circle, with radial sewers all meeting at one point. Peak flows from the different buildings would reach the outlet at the same time, forming one large peak. Thus it is seen that the variations in flow depend much on the layout of the camp and arrangements of the sewer-

age system. Generally speaking, however, the peaks were more like the first illustration, otherwise it would have been necessary to provide disposal works and outfall sewers of much larger capacity than actually was the case.

SEWAGE TREATMENT.

When orders were issued to construct and have ready within a period of four months 32 army camps, the advisory engineers associated with the Cantonment Division were confronted with the problem of laying down a policy with respect to sewage treatment. Time-consuming investigations of local conditions at each place were out of the question. Also, it did not seem advisable to leave the decision as to type of plant and degree of treatment to the several engineers selected to look after the installation of the water works and sewerage. This policy would have involved duplication of work in preparing plans of tanks, filter beds and other units which would best be designed in the central office. Furthermore, the installation of plants representing many different types according to the ideas of engineers practicing in the different parts of the country would have been unwise, since the conditions with respect to character of sewage and variations in sewage flow were more or less similar for all the camps. Decision as to the degree of treatment was usually made in accordance with the recommendations of the engineers in the field, who were familiar with local conditions.

The type of tank adopted by the Government differs in design and method of operation from tanks previously used in municipal practice. The engineers responsible for the selection of this had to take into consideration several items: (*a*) Limited time for construction; (*b*) cost; and (*c*) unusual character of sewage, which contains a larger percentage of scum-forming material than municipal sewage.

The keynote of the camp-construction program at that time was speed. The camps had to be ready to receive troops early in September, the driest period of the year, when sewage works are needed most of all.

It was consequently decided to adopt a type of tank which for a number of years had been in successful use at Government

posts and reservations. Compared with Imhoff tanks, these could be constructed in a much shorter time and at less than half the cost. Furthermore, the tank is especially designed to operate on the "flotation" principle, and therefore peculiarly adapted for treating army-camp sewage.

At the same time it was recognized that the adoption of this type of tank involved a more difficult operating problem, as has proved to be the case. In view of the uncertainty as to the length of the war and that the majority of installations would be temporary only, decision in favor of speed and low first cost, rather than economy of operation, was undoubtedly a wise one.

The original tanks for receiving sewage from the main camps were, as a rule, designed on the basis of 10 gals. capacity per capita, based on the authorized personnel. For example, if the camp was built for 40 000 men, the capacity of the tanks was made 400 000 gals. Observation of the tanks in actual operation early indicated the advisability of providing larger capacity. In July of 1918 it was decided that the tanks at the major camps, with one or two exceptions, should be increased to 35 gals. per capita. Construction was authorized immediately and additional units were well on toward completion when orders were issued in November, 1918, to abandon all new construction work.

Experience with these tanks of limited capacity showed the necessity of operating them on the sedimentation principle, with the object of obtaining a high degree of clarification and not attempt particularly to secure digestion of the sludge. This method of operation required frequent removal of scum and sludge, especially from the first compartment, where it accumulates most rapidly. Instructions issued on August 1, 1918, provided for removing scum and sludge at weekly intervals when necessary. Supplementary instructions issued later provide that the combined thickness of scum and sludge in the first compartment shall not exceed five feet. As is to be expected, the material removed from the first compartment is undigested and consequently must be turned into trenches and covered with earth immediately on removal. The sludge accumulating in the remaining hoppers becomes partially digested before removal,

and usually can be disposed of on artificial drying beds without difficulty.

In brief, the greatest usefulness of this type of tank is realized when it is operated to secure a high degree of clarification with sludge digestion a secondary consideration. Naturally, this method involves a difficult and intensive operating program. Disposal in trenches of scum and sludge intercepted in the first compartment entails a relatively heavy labor item. It is doubtful if a municipality would undertake to maintain a plant of this type on account of the high operating cost. It is true that this item of expense can be reduced by allowing the several compartments to fill with sludge, but this results in a gradual increase of suspended matters escaping with the effluent, thereby defeating the primary object of tank treatment. At camps, soldier labor is not an item of extraordinary expense, and for the comparatively short intervals the majority of these plants will be maintained the standard tank has all the efficiency required.

The Government, in the matter of sewage treatment, has not only tried to conform with the state laws and regulations, but has even installed works where there was a question whether treatment was really necessary in the interest of public welfare. Sprinkling filters were installed at Camps Dix, Gordon, Meade and Pike, and in each case provision made for disinfecting the effluents with chlorine. At Newport News, sewage tanks and disinfecting apparatus were installed at Camps Hill and Stuart at the request of parties interested in the oyster-growing areas in the vicinity. Twelve of the 32 hospitals of the national army and guard camps have separate disposal works, and, of these, five include sprinkling filters and two sand filters.

So far there has not been a suit for damages instituted against the Government on account of nuisance along the stream receiving the effluent. In a number of instances where attention has been invited to certain conditions, prompt investigation has been made and such steps taken to improve the conditions as the circumstances in the case required.

Grease Recovery.

One of the most interesting developments in connection with sewerage at army camps has been the importance of intercepting grease from kitchens. This subject, up to the time the camp sewage plants were put into operation, had been practically overlooked. Literature on sewerage practice in this country contains only a few references to this item, and engineers had given the matter very little consideration.

The typical plans at first adopted for sewerage systems at camps provided that a tile grease-trap should be installed on each kitchen line. These tile traps are 18 ins. in diameter and of the ordinary type on the market. As soon as the sewage tanks were put into operation it was discovered that grease was a factor to be specially reckoned with. The tile traps were found to be practically useless. Investigation of sewage tanks at the various camps showed that some of the trouble with scum was undoubtedly due to the large quantity of grease which reached the plant. The grease which was mixed with the scum and sludge made it difficult to settle the latter for removal through the sludge pipes. What was obviously required was a trap of a larger capacity to permit the liquid to come to rest or practically so. Traps should be large enough to take care of the peak loads directly after meals.

The flow from kitchens comes in sudden gushes. Experiments conducted at Fort Myer by the Sanitary Corps showed that the average flow per capita per day from the kitchens was 2.4 gals. A maximum rate of flow of 1.5 to 2.0 gals. per capita per hour was observed. However, those sudden gushes cover short periods varying from five to fifteen minutes. During a ten-minute interval, therefore, the flow from the kitchen serving 200 men on the basis of the above figures would be from 50 to 67 gals.

A trap is required of sufficient capacity to take care of these sudden surges, allow for some cooling of the liquid in passing through the trap, and to permit the accumulation of grease during the period of a week without any great reduction in the capacity of the trap. The tile traps were entirely too small to take care of the peak flows. At such times any grease which

accumulated in the trap was washed out through the outlet. The shape of the trap also has a great deal to do with this efficiency. For instance, the outlet must be so arranged as to prevent as far as possible accumulation of organic matter in the bottom.

Traps of the new type installed at the various camps had capacities ranging from $\frac{1}{4}$ gal. to $\frac{3}{4}$ gal. per capita, based on the number of men served in the kitchen. The records in quantities of grease recovered indicate that the capacity of $\frac{2}{3}$ gal. per capita for the latest type of trap is sufficient. Such a trap requires cleaning weekly.

Data from various sources show that the quantity of grease recovered per capita per year is about 10 to 12 lbs., and the market value of this grease at the present time is about 10 cents, or, in round numbers, $1.00 per capita per year. The population of all the camps during the past summer was about 1 000 000 men. If all the kitchens had been provided with traps the total potential income per day on the basis of the above figures would have been $2 750, — equivalent to $1 000 000 per year. Thus the installation of grease traps instead of being an item of expense should be a source of profit. However, the money return in reality is a secondary consideration in comparison with the need of these traps for protecting the sewer lines and preventing grease from interfering with the proper functions of the treatment works. The additional expense incident to the cleaning out of sewers clogged up with grease, and sludge trouble caused at the disposal plant on account of such grease, cannot be calculated.

There is no doubt that the discoveries along this line during the past year will have an important influence on future engineering practice. Sewage from large institutions and many residential districts is very similar to sewage from camps. The advantage of grease traps in connection with such projects will quickly be recognized, particularly at places where there are treatment works.

The condition of the sewerage systems, due to grease accumulation therein, has already been referred to, as has this necessary spring program for cleaning sewers and building grease traps to prevent such accumulations in the future. Material augmentation of the disposal-plant capacity at camps will

also require to be carried forward. Extensive repairs and replacements of work-pumping machinery, and ill-conditioned or inadequate sewer lines are required. The Government cannot long expect to get by with the emergency program for sewage treatment, and in peace times the requirements as to degree of purification will be far more exacting.

This extraordinary work, and the operation and maintenance of sewer systems and plants, is estimated to cost $6.50 per capita during the current year.

DISCUSSION.

RICHARD MESSER.* — The question of grease recovery has been one of the interesting developments, in connection with the operation of sewerage works at army camps, although the grease problem was not appreciated in the summer of 1917, when construction of the camps began. There are very few references on this subject in the literature on sewage treatment. However, from the experience at army camps we know now that many of the troubles in connection with institutional sewage plants and plants receiving mostly domestic sewage were due in part to grease.

The original specifications for sewerage systems at the camps provides for the ordinary tile traps on the market, 18 and 24 ins. in diameter and about 30 ins. in depth. It was soon evident that these traps were of very little value. As soon as it became apparent that grease was seriously interfering with the functioning of the sewage tanks, the subject of providing larger and more efficient traps was taken up. Since then traps of various sizes and shapes have been tried out, until a design has finally been evolved under the supervision of Major Doten which appears to be fairly satisfactory.

The question of the best size of trap for camp conditions has not been settled definitely. Opinions have varied as to the advisability of building traps having total capacities of $\frac{2}{3}$ gal. per capita (based on the number of men served in a kitchen) and larger traps of 2 and $2\frac{1}{2}$ gals. per capita. During the last six

* Major Quartermaster Corps, U. S. A., officer in charge Water and Sewer Section Maintenance and Repair Branch of the Construction Division, U. S. A.

months data received from camps relative to the quantities of grease scum collected from traps of various sizes seem to indicate that the 2- and 3-gal. per capita traps are more efficient than those of the $\frac{2}{3}$-gal. per capita type.

The following figures taken from reports submitted by the utilities officers at Camp Merritt and Camp Meade are given below. In each case the quantities collected were carefully recorded by special request from the Washington office, and for the particular purpose of securing reliable data on this subject.

CAMP MERRITT.

Capacity of Trap. Gals. per Capita.	Number of Cleanings.	Grease, Scum. Lbs. per Capita per Year.
0.30	3	17.9
0.50	7	7.2
0.60	82	16.1
0.70	22	7.4
0.80	9	11.8
0.90	3	11.1
1.	12	27.3
2.	2	77.7
3.	16	100.1
Total	156	

CAMP MEADE.

Capacity of Trap. Gals. per Capita.	Number of Cleanings.	Grease, Scum, Lbs. per Capita per Year.
0–0.5	2	11.7
0.5–0.75	9	12.0
0.75–1.25	130	19.2
1.25–2.00	68	23.2
2–3	27	69.7
3–4	25	65.7
Total	261	

The figures for Camp Merritt are for the period beginning November 16 and ending January 28. The intervals between cleanings varied from seven to twenty-eight days, with an average interval of about fourteen days.

The Camp Meade figures are for the month of December,

with shorter intervals between cleanings, three to seven days, with an average of about five days.

The gradual increase in efficiency in direct proportion to the increase in the size of traps is apparent from the above figures. However, it should not be interpreted from these remarks that a conclusion has been reached. Reports are still coming in and will be tabulated. It is hoped that these investigations will stimulate the collecting of similar data at other places.

The most important factor which must be taken into consideration in the design of grease traps is the maximum or peak flows which usually occur directly after meal time. Experiments conducted at Fort Myer, under the supervision of the Sanitary Corps, showed an average flow from a kitchen of 2.4 gals. per capita per day, that for intervals varying from ten to fifteen minutes the flows were as high as 1.5 to 2 gals. per capita *per hour*. Assuming these latter maximum rates, the flow during a ten-minute interval from a kitchen serving 200 men would be 50 and 67 gals. respectively.

Grease traps should be placed in the kitchen drains as near the buildings as practicable. Sewage from toilets should not be allowed to flow through the traps.

The type of tank now being installed is square, with a pyramidal bottom. The depth from the flow line is about 3 ft. 2 ins. for traps of the ordinary sizes. An interesting feature is the small outlet ($2\frac{1}{2}$ ins.) extending from the hopper bottom up to the flow line. During periods of peak flows a self-cleaning velocity is created which tends to carry out any settleable material which would otherwise soon clog the outlet. About 9 ins. above the flow line is an emergency overflow. Should the outlet clog, the water level in the trap gradually rises, thereby creating a head which tends to free the outlet and at the same time flush out any light material which has collected in the hopper bottom. It should be mentioned again that Major Doten has developed all these features.

Precautions should be taken to exclude so far as possible coffee grounds and other heavier materials which would cause trouble by clogging. At camps, sink drains are provided with screens.

One of the troubles at camps was due to men removing the covers and throwing in garbage and other wastes. This was remedied by providing covers with locking devices or by making covers so heavy that they cannot be easily taken off.

To secure satisfactory results, grease traps should be cleaned at regular and frequent intervals. The usual practice at camps is to clean each trap once a week or at least once in two weeks.

In regard to the operation of sewage tanks, I might add just one more word to what Colonel Johnson has said. Since August of last year instructions have been given to operate tanks on the sedimentation principle and to regard sludge digestion as of secondary importance. Experience has shown that the secret of securing efficient clarification (and it is possible to get very good clarification from these tanks) is to keep the first compartment comparatively clean. In other words, our operating instructions state that the combined thickness of scum and sludge in the first compartment shall not be allowed to exceed 5 ft. When this amount of material has been collected it shall be drawn off whether digested or not. As a general rule, when a tank is working at capacity, very little digestion occurs in the first compartment and the sludge drawn off must be disposed of in trenches. With this method of operation the settleable material which passes into the second, third and fourth compartments will usually sink to the bottom in the form of sludge, and very little scum will be formed. The tests at Camp Custer, which were made under the supervision of Capt. C. B. Hoover, showed that it was possible to secure a very high degree of clarification. With clean tanks, the clarification, determined by Imhoff glasses, was usually above 95 per cent. and sometimes as high as 100 per cent. A removal of 90 per cent. or more of the settleable solids determined on the basis of 2-hr. settling periods, is a reasonable expectancy with a retention capacity in the tank of 10 gals. per capita or more.

The above instructions in regard to keeping the first compartment clean and drawing off undigested material applied when the sewage tanks were working at full capacity or at high rates. During the last few months the populations at most of the larger camps have been reduced at least 50 per cent. Addi-

tional tank units authorized last summer have been completed. Consequently, at the present time sewage tanks have capacities ranging from 50 to 70 gals. per capita, or about five times as great as last year.

Instructions have recently been issued to operate the tanks in rotation, in the same manner as is done at Washington, Pa., and has been tried out at Plainfield, Columbus and other places. Briefly, this method consists of running the entire flow of sewage through one tank battery until there is evidence of disgorging of settleable solids in the effluent. The battery is then cut out of service and the next put into operation. The scum and sludge, however, is not removed until all other batteries have been used. This allows a period of five to seven months for retaining sludge in the tank and during which time digestion may be expected. To facilitate digestion the large amount of settleable material which collects in the first compartment will be distributed to the other compartments at the time the unit is cut out of service.

The grease scum contains considerable impurities and water mixed with it. A carefully conducted test showed that 1 028 lbs. of grease scum were rendered into 720 lbs. of refined grease, or about 70 per cent. This grease, of course, can be used for various purposes and during the period of the war brought a price ranging from 10 to 20 cents per pound.

At Camp Gordon we have had some trouble in getting rid of the scum and sludge. One reason for this is the lack of available area in the vicinity of the plant for the disposal of sludge. The plant itself is located not very far from occupied buildings. The limited area on the hillside across the stream from the plant was practically used up last year for the disposal of sludge in trenches, and since then there has been considerable difficulty in finding suitable space for trenches. Some months ago an attempt was made to remove this sludge by pumping through a pipe line to an area located about one-quarter mile away from the tanks. This scheme was not very successful, and at the present time scum is being removed from the top of the tank and hauled away in wagons.

LEONARD METCALF.* — Perhaps I might say just one word in regard to the tanks to which Colonel Johnson has referred, with special reference to the basis of design adopted, so that it will be made clear to you. I say this because I hope that none of you will go away with the idea that these tanks can be used for municipal practice on any such basis of design as was planned in their original construction. The problem with which the Construction Division was confronted was this: The camps were to be designed for a maximum period of time of five years, with the possibility that they would not be used for more than two. It was thought that they would probably be used for at least two years, but perhaps not for a longer time than that. Therefore the designers were confronted with the question as to what was the economic line of division between first cost and operating cost, and it seemed more prudent, particularly in view of the difficulty of building the tanks in time for the occupation of the camps, to adopt a form which would involve a low construction cost and high operating cost.

The difficulty in the functioning of these tanks has arisen from the fact that many have conceived of them as being digestion tanks. Those who passed upon them originally did not so regard them — except Major Doten. We felt that they should be regarded essentially as sedimentation tanks, and if so operated the tanks would do the work of clarification, and that was all that was thought necessary in the majority of cases. Where it is necessary to carry the purification to a higher degree, it was thought additional capacity, or filters or other devices to accomplish this additional purification, could be added later. As soon as it was appreciated, by those who were operating the tanks, that they had to be operated on the sedimentation rather than the complete digestion basis, they functioned properly, and early difficulties, such as clogging, were surmounted. This did not eliminate the disagreeable task of handling the solids, however, and Colonel Johnson is quite right in saying that nobody appreciated the seriousness of the grease problem. I think that the Construction Division has contributed something

* Of Metcalf & Eddy, Consulting Engineers, 14 Beacon Street, Boston, Mass.

of substantial value to the art of wastes disposal, in the grease trap which has finally been evolved by it, and of the operation of which Major Messer has told you.

As bearing on the effect of grease on sewage, I was very much interested in conditions developed at Camp Gordon, at Atlanta. The scum and sludge were distinctly acid. Some of this sludge had been taken out of the tanks and buried in trenches 8 or more feet in depth, and then covered with bagging and oil put on top to prevent the breeding of flies.

I asked them to open up some of the trenches. The sludge had been in them between two and three months, I think. It was in May or June that I saw them. No change had taken place in the sludge except a reduction in the moisture content, and the fly problem was a very serious one. Major Hommon told me he that had found in some trenches where the grease was deposited and covered with 5 ft. of clayey material, that flies had come up through it. He said that he had heard of flies coming up through 4 or 5 ft. of sand, but never through this distance of clayey material. This made us very apprehensive. At that time, too, there was also considerable trouble with the development of flies in the scum in the tanks.

The tanks were being relieved of a part of the sludge and scum in them at that time, with a view to operating them on the sedimentation basis. An attempt had been made to operate them on the digestion basis, and had failed.

The day before we got there they had treated the tanks with a very heavy dose of oil, which had killed the larvæ, but we found that even then (twenty-four hours later), where the material was cracking open, larvæ were still at work, and oil had to be applied again.

We thought at that time that it might well prove necessary to handle this sludge and remove it within the life cycle of the fly.

Almon L. Fales* (*by letter*). — It was a keen disappointment to me to be unable to attend the annual meeting of the Sanitary Section and hear Colonel Johnson's address on "The Operation and Maintenance of Utilities at Army Camps and

* Of Metcalf & Eddy, Consulting Engineers, 14 Beacon Street, Boston.

Cantonments," and the discussions by Major Messer and others. I have read with great interest the stenographer's transcript of the address and discussions, and am impressed more than ever with the magnitude and importance of the work which Colonel Johnson and Major Messer have been doing.

I appreciate Colonel Johnson's kind words concerning my part in the preparation of the "Manual of Operation of Water and Sewage Works," but feel that he gives me altogether too much credit. Although I did prepare some suggestions for Colonel Johnson along those lines while in Washington, there was so much left to be done when I came away that I feel entitled to little credit for the final document.

In connection with the work of the consulting engineers, Fuller and McClintock and Metcalf & Eddy, employed by the Construction Division, it was my privilege to inspect the water supply and sewage-treatment facilities at numerous army camps and to make careful investigation of the efficiency of these facilities in several of the camps. I am therefore in a position to testify that Colonel Johnson and Major Messer were confronted with many and varied problems in the water and sewer section alone. The Construction Division and the Maintenance and Repair Branch, in particular, is indeed fortunate that these problems were in such competent hands.

I have followed the work of the Water and Sewer Section with great interest. Where the water supply was found to be inadequate or unsatisfactory in quality, steps were taken to remedy the defects. Where the use of water was abnormally large, steps were taken to determine possible sources of leakage. In the case of leaking sewers or manholes on the sewer system receiving surface water, steps were taken to make the necessary repairs. In the case of the grease traps which were found to be unsatisfactory, provision was made for installing larger traps of improved design. In the case of the sewage tanks which were found to be inadequate for digestion of the sludge, provision was made for additional tanks of improved design. Many additions and improvements for water supply and sewage treatment were either completed or well under way when the armistice was signed.

Colonel Johnson and Major Messer have discussed the methods of operation of the sewage tanks and the difficulties encountered in the disposal of the sludge. It may be helpful to describe briefly the type of tank referred to, which was designed by Major L. S. Doten, of the Engineering Branch.

The tank installation for a divisional cantonment consists of two units of four compartments each. Each compartment is 23 ft. 6 ins. square in plan, and provides for a depth of 7 ft. 9 ins. from the water level to the top of the hopper bottom, and the hopper bottom is 6 ft. 6 ins. deep at the center, with the sides on a slope of 1 on 2. The bottom baffles, or sludge partitions between the compartments, are of concrete, and extend to within 12 ins. of the water level. A top baffle, or scum partition, also of concrete, is placed in front of each sludge partition, at a distance of 2 ft. 3 ins. from it. The distances between the top of the hopper bottoms and the lower end of the scum partitions are 18 ins., 12 ins., 6 ins. and 0 ins., in the first, second, third and fourth compartments, respectively. The sewage enters the two tanks through openings in adjacent corners and flows through the tanks in parallel, the effluent from each passing over the edge of a collecting trough extending entirely across the outlet end of the tank.

A cast-iron pipe is provided for the removal of sludge from each hopper. The pipe for the first compartment is 10 ins. in size and the others 8 ins. The ends of these pipes are notched to rest on $1\frac{1}{4}$-in. horizontal bars placed 4 ins. above the hopper at the center. A short distance above the bottom these pipes turn from the vertical at an angle of 45 degrees and pass through the side wall of the tank, emptying into the sludge main which is of 8-in. and 10-in. cast-iron pipe. For the first compartment of each tank a vertical sludge pipe extension is afforded, for agitating the sludge to facilitate its removal.

The objects which can be attained by tank treatment of sewage without the use of chemicals may be enumerated as follows:

1. Removal of suspended matters which will settle to the bottom or rise to the top.

2. Digestion of the solids removed, with the production of inoffensive sludge and scum.

3. Reduction in oxygen requirement of the sewage, for bacterial oxidation of organic matter.

The first object (sedimentation and flotation) was obtained by the Doten tank until the accumulation of the undigested sludge and scum became so great that portions of it were carried away in the effluent at times of high flow. It then became necessary to remove a part of this accumulation, and great difficulty was experienced in getting it out, owing to the clogging of the sludge pipes, due in part to the obstruction offered by the supporting rods on which the sludge pipes rested. By sufficiently frequent removal of sludge and scum the third object (reduction in oxygen requirement) was also attained.

The second object (digestion of solids) was not attained by the Doten tank with a capacity of 10 gals. per capita, and tests at Camp Custer indicated that complete digestion of the solids could not be secured even with a capacity as high as 35 gals. per capita. In several cases some well-digested sludge was produced in the third and fourth compartments, but so far as I am aware, in no case was the rate of production of well-digested sludge equal to the rate of accumulation of undigested material. In some cases where digestion was active, the tank effluent was found to have a higher oxygen requirement than the crude sewage itself, thus defeating the third object of the tank treatment.

The provision for five tank units, recommended by the consulting engineers, was to enable the tanks to be operated in rotation, one at a time for sedimentation, followed by a period of rest for sludge digestion and thus to secure all three of the objects which may be attained by tank treatment. It was also recommended that provision be made for pumping the sludge and scum from any compartment of any tank to any other compartment, to facilitate digestion of the solids.

Vol. VI JUNE, 1919 No. 6

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PROCEEDINGS

PAPERS IN THIS NUMBER.

"The Movement to establish a National Department of Public Works." Frederic H. Fay.

Memoir of Deceased Member.

Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

MINUTES OF MEETINGS.

BOSTON, May 21, 1919. — A regular meeting of the Boston Society of Civil Engineers was held this evening in Chipman Hall, Tremont Temple, and was called to order at 7.50 o'clock by the President, Leonard Metcalf.

The attendance at the meeting was 90, including members of the Boston Section of the American Society of Mechanical Engineers and members of the New England Water Works Association, who had been invited to join in the meeting.

The reading of the record of the last meeting was dispensed with, and it was approved as printed in the May JOURNAL.

The Secretary reported for the Board of Government the election to membership of the following:

As a Member — Mr. James E. Cashman.

As a Junior — Mr. Elmer P. Rankin.

The Secretary also reported the adoption by the Board of the following vote:

That the Board of Government of the Boston Society of Civil Engineers heartily approves the movement for the establishment of a National Department of Public Works, and recommends that the Society actively support the project through appropriate campaign committees appointed by the Board, and coöperation with the committees of other professional and business organizations that may become interested in the movement.

At the suggestion of the President, action on the recommendation of the Board was postponed until later, so that members might have the benefit of the evening's discussion on the subject. Before the close of the meeting, on motion of Mr. Wason it was unanimously voted:

That the meeting approve the action of the Board of Government of the Boston Society of Civil Engineers upon the matter of a National Department of Public Works as expressed in the foregoing vote.

The Secretary presented the memoir of Rufus M. Whittet, a member of the Society, who died December 10, 1918, which memoir was prepared by a committee consisting of Messrs. X. Henry Goodnough and John J. Van Valkenburgh, and by vote it was accepted and ordered printed in the JOURNAL.

The death of John A. Gould, a member of the Society, which occurred May 18, 1919, was announced, and by vote the President was requested to appoint a committee to prepare a memoir. The President has named, as the committee, Messrs. Desmond FitzGerald and William A. Wood.

It was voted to hold the next regular meeting on June 25, 1919, in connection with a joint outing of the New England Water Works Association and this Society.

The Secretary reported that a portrait in oil, suitably framed, of John Harrison Blake, the first Secretary of the Society in 1848 and 1849, had been presented to the Society by the estate of his son, Dr. Clarence J. Blake, and that the Board of Government had made fitting acknowledgment of the gift.

The President then extended a most cordial welcome to the members of the local section of the American Society of Mechanical Engineers. He said that it was very desirable and pleasant for engineers to get together from time to time in this way, in order to discuss movements in which all are interested.

"The particular subject for discussion to-night," he said, "is the movement instituted by Engineering Council, for the establishment of a National Department of Public Works, to have charge of the construction activities of the Government. The Society sent as its representative to the conference called to meet at Chicago on April 23–25, a past president of this Society, Mr. Frederic H. Fay, who will make report to you to-night."

Mr. Fay then read his report, which is printed in this number of the JOURNAL.

The President then turned over the further conduct of the meeting to Mr. W. G. Starkweather, chairman of the Boston Section of the American Society of Mechanical Engineers, who in turn introduced the other speakers of the evening, Dr. Ira N. Hollis, a past president of both the American Society of Mechanical Engineers and the Boston Society of Civil Engineers; Mr. Walter B. Snow, a member of the Committee on Aims and Organization of the American Society of Mechanical Engineers; and Mr. Calvin W. Rice, secretary of that society. President Metcalf closed the speaking of the evening with especial reference to the question of civil *versus* military control of the National Department of Public Works.

A full report of the discussions had at this meeting is printed in this number of the JOURNAL.

Adjourned.

S. E. TINKHAM, *Secretary.*

BOSTON, MASS., May 7, 1919. — A special meeting of the Sanitary Section of the Boston Society of Civil Engineers was held this evening in the Society Library, Tremont Temple.

The meeting was called to order at 7.45 o'clock by the

chairman, Edgar S. Dorr. The records of the annual meeting were approved as printed in the JOURNAL.

The speaker of the evening, Prof. C. T. Brues, of Bussey Institute, gave a very interesting talk on "The Sanitary Control of Mosquitoes, Flies and Other Insects."

Professor Brues described the different insects, their life histories and their control, as viewed from the sanitary standpoint.

The talk was illustrated with lantern slides.

The subject was discussed by Messrs. Lewis M. Hastings, Leonard Metcalf, Edward Wright, Jr., and Frank A. Marston.

It was voted to extend a rising vote of thanks to Professor Brues for his courtesy in presenting the paper.

There were 26 present. Adjourned at 10.00 P.M.

JOHN P. WENTWORTH, *Clerk.*

APPLICATIONS FOR MEMBERSHIP.

[June 16, 1919.]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

FOX, WALTER SCOTT, Allston, Mass. (Age 24, b. Allston, Mass.) Graduate of Lowell Inst., 1910. From September, 1915, to August, 1916, draftsman with Stone & Webster; from August, 1916, to date, with exception of short time in military service, engineer with E. A. Tucker Co. Refers to H. A. Gray, E. A. Tucker, F. S. Wells and J. F. Wilber.

ROWE, RANSOM I., Brighton, Mass. (Age 52, b. Burlington, Vt.) Has been engaged in engineering work for over thirty years; during past sixteen years has been contractor on water works, roads, bridges and tunnels; is now president of Rowe Contracting Co. Refers to C. R. Gow, Channing Howard, E. S. Larned, H. A. Miller and J. R. Rablin.

VARNEY, EDWARD ALLEN, Cambridge, Mass. (Age 24, b. Orange, Mass.) Worcester Polytechnic Inst., 1912–16. During summer of 1912, with Union Twist Drill Co., Athol, inspection dept.; summer of 1913, with Associated Efficiency Engrs., New York City, on efficiency and cost work; summer of 1914, with Reed Prentice Co., Worcester, on mechanical drafting and filing work; summer of 1915, with Central Bldg. Co., Worcester, on Worcester Tech. gymnasium; from June, 1916, to November, 1917, structural detailer and designer with Eastern Bridge & Structural Co.; from December, 1916, to January, 1917, loaned to New England Structural Co.; from December, 1917, to March, 1918, draftsman and designer with Aberthaw Construction Co.; March 10, 1918, loaned to Fay, Spofford & Thorndike, work consisting of drafting, some design and checking on Boston Army Supply Base; from October, 1918, to date, asst. to head of Applied Mechanics and Strength of Materials Dept., Wentworth Inst. Refers to C. R. Berry, C. A. Farwell, F. H. Fay, H. F. Sawtelle, C. M. Spofford, H. C. Thomas and S. H. Thorndike.

EMPLOYMENT BUREAU.

THE Board of Government maintains an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society rooms two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

MEN AVAILABLE.

459. Age 22. Graduate of Rindge Technical School and student for one year at George Washington University. Has had two years' experience in engineering work, including one year as structural draftsman with bridge

department of railroad. Desires position as structural draftsman. Salary desired, $25 per week.

460. Age 27. Graduate of Mechanic Arts High School, Lowell Inst. (buildings course), and U. S. Navy Steam Engrg. School. Has had nine years' engineering experience, including topographical surveying and industrial and power-plant design and construction; experience covers both field and office work; since October, 1917, in U. S. Navy; recently released with rank of ensign. Desires position in any capacity for which above experience qualifies him.

461. Age 32. Graduate of Lowell Inst., mechanical and buildings courses; student for two years at Mass. Inst. of Technology. Has had four and one-half years' experience on general survey work for U. S. Engineer Office, three years as resident engineer in paper mill, two years as designer in office of consulting engineer; and one and one-half years as army officer; was member of Planning Board of General Staff in France; recently discharged with rank of captain. Desires executive position.

462. Age 28. Graduate of Mass. Inst. of Technology, sanitary engineering course. Experience covers two years in engineering division of state department of health; eleven months in Balkans as member of American Red Cross Sanitary Commission, on epidemic work, general sanitation and civilian relief; eight months on construction and operation of water-purification and sewage-disposal works in New York state; and one year in France as lieutenant of engineers on water-supply work. Desires position in connection with sanitation or public health. Salary desired, $2,000 per year.

463. Age 20. Student for one year at Bentley's College and for one year at Wentworth Inst. Has had one year's experience as timekeeper and estimator. Desires position as timekeeper or material clerk. Salary desired, $23 per week.

464. Age 20. Received technical education at Mechanic Arts High School and Wentworth Inst. Has had two and one-half years' experience, including six months as draftsman with engineering firm and one year on railroad work. Desires position as transitman or timekeeper. Salary desired, $25 per week.

465. Age 29. Educated in public schools and at Boston Y. M. C. A. Evening School. Has had twelve years' experience as rodman, draftsman and transitman; experience includes municipal work and railroad location and construction; for four years has conducted own office. Desires position as surveyor. Salary desired, $150 per month.

466. Age 30. Graduate of Mass. Inst. of Technology, civil engineering course. Has had about seven years' experience, chiefly on building construction; has had responsible charge of important concrete construction, including work as assistant engineer, construction engineer and superintendent of construction for Construction Div., U. S. A. Desires permanent position as assistant superintendent on construction or maintenance, preferably in or near New England. Salary desired, $200 per month.

NOTES FROM ENGINEERING COUNCIL.

It is proposed to print in this place from time to time notes from Engineering Council, which is a department of the United Engineering Society.

On this Council each founder society has five representatives, and United Engineering Society is represented by four of its trustees, one from each founder society, and the American Society for Testing Materials has one representative. Other national engineering or technical societies may be admitted to membership. Early this year the American Society for Testing Materials became the fifth member of Engineering Council. Admission of other than national societies is under consideration and has been recommended by Council.

Engineering Council has defined its field in the following resolutions:

Whereas, the By-Laws of United Engineering Society stipulate that Engineering Council is to provide for convenient coöperation between engineering societies, "for the proper consideration of questions of general interest to engineers and to the public, and to provide the means for united action upon questions of common concern to engineers," and that "Council may speak *authoritatively* for all member societies on *all public questions* of common interest or concern to engineers, unless objection be made by a majority of the representatives present of one of the founder societies or by one quarter of the representatives present and voting,"

Resolved, that Engineering Council understands its field of activity to be approximately as follows:

(1) Council may deal with any matter of general interest for which joint action of two or more of its member societies would have been appropriate, if Council had not been established.

(2) Council may initiate and carry through projects of the general character defined in the By-Laws, for which the necessary financial provision has been made; but Council shall not undertake expenditures in excess of appropriations for its uses made by United Engineering Society on behalf of the founder societies and the contributions from other member societies, unless specific provision shall have been made therefor by subscription, donation or otherwise: moneys received by Engineering Council shall be turned into the treasury of United Engineering Society and disbursed by it, for the purposes designated.

(3) Council may take up, and in its discretion act upon, any matter

of general interest referred to it by any member society or by any other society, national, state or local, or by any branch of Government, or by any individual or group of individuals.

Resolved, that Engineering Council will as a rule avoid considering any matter which is specifically within the province of only one member society and not of others.

The nature of its activities may be illustrated by the following matters, to mention only a few, which have been taken up recently:

Its War Committee of Technical Societies embraced representatives of eleven technical organizations and was closely associated with the Naval Consulting Board and the Inventions Section of the Army General Staff. Of both these governmental bodies the chairman of the committee was a member. This committee assisted in reviewing 135 000 suggestions for military and naval devices and in stimulating the solution of war problems.

Provision for army field construction was proposed by a major of the British Transportation Service, by so organizing all fighting units as to have a definite proportion of engineers and construction foremen among the officers to direct the necessary construction at the front. After repeated conferences and extended correspondence, Council was assured that the need would be properly met in the American Army.

Advocates of an American Academy of Engineers were given several hearings and the matter was very carefully considered, but in the end Council declined to support the bill before the House of Representatives for the establishment of an academy.

In coöperation with the Chamber of Commerce, U. S. A., Council gave information about water power while bills were before Congress.

A Water Conservation Committee has been created, to deal broadly with questions concerning utilization and control of water in all parts of the country for municipal supply, power development, navigation, irrigation, sewage disposal, flood control and other purposes; to promote such consideration of water resources by Congress and legislatures as will result in conservation rather than unintelligent appropriation to a narrow

use at the expense of some more important use, also to encourage wise development.

A Committee on Licensing of Engineers was created at the beginning of the year, after long efforts to secure proper membership. The committee has fifteen members in thirteen different states, its chairman and two others being in Chicago. The country has been divided into thirteen districts, each assigned to one member of the committee, for the collection of information relating to present and proposed laws concerning the licensing of engineers and architects. This matter is receiving active attention by large numbers of engineers as well as the legislatures of several states. Because of common interest, the American Institute of Architects was recently invited to coöperate in seeking uniform legislation for engineers and architects in all the states.

Ten days after the armistice, Council organized Engineering Societies Employment Bureau. Since December 1, 1918, it has filled 2 500 applications for employment, has placed 500 engineers in positions, and has conducted hundreds of personal interviews. About 90 per cent. of the applicants are men returning from army, navy or other war service. Needs additional appropriation of $6 000, making total for year $13 500. No charge is made for this service, and it is open not only to members of the societies, but to non-members introduced by members. The service is appreciated, especially because of the discrimination and intelligence with which it is managed. It is conducted largely by personal interviews. Requests for men for many important engagements are coming to this office, as well as those for minor positions. The cost of this service for the current year is estimated at $16 000, including salaries, offices and miscellaneous expenses.

In the closing month of 1918, Council created a National Service Committee, establishing it in an office in Washington, with a chairman and small staff engaged to give their time to work at the national capital for engineers in all parts of the country, including a bureau to supply on request information concerning congressional and departmental activities.

It aided in the reinstatement of 350 "subway" engineers unfairly dismissed January 1, 1919, by the City of New York.

Council has made repeated efforts to secure better classification and compensation of engineers in railroad employment.

On invitation, Council explained to a Senate Committee the possibilities of a National Department of Public Works.

Council, through its Washington office, opposed the Kenyon bill, giving the engineer corps of the army control over federal construction and over state and municipal work receiving federal aid. It did not pass.

National Service Committee conducted a conference in Chicago, April 23 to 25, to determine whether Engineering Council should advocate a National Department of Public Works. The conference was attended by representatives of organizations of engineers, architects, constructors, geologists and chemists, having membership of over 105 000. The conference organized for pursuing its purposes, and established several working committees.

Besides the usual Executive, Finance, Nominating and Rules committees, Engineering Council has the following committees whose suggestive names well indicate the breadth and character of the work carried on: Advisory Committee to the New York State Reconstruction Commission, Americanization, Classification and Compensation of Engineers, Curricula of Engineering Schools, Engineering Societies Employment Bureau, Fuel Conservation, International Affiliation of Engineers, Licensing of Engineers, National Service, Patents, Public Affairs, Publicity, Publicity Methods, Reconstruction, Water Conservation. These committees are active in accordance with the needs of their several fields. Several committees have been discontinued, their duties having been done.

To maintain some communication, although informal, with groups of engineers throughout the country, Engineering Council has approximately thirty-five local correspondents in as many centers of engineering population. Canadian engineers have repeatedly expressed desire for friendly relationships with Engineering Council, and at its meeting February 20, Council appointed three members of a joint committee on International

Affiliation of Engineers, to which the Engineering Institute of Canada also has appointed three members.

From the beginning of its existence, Engineering Council recognized the desirability of establishing at the national capital an office to represent the engineering profession. Ways and means for accomplishing this purpose did not appear until the end of 1918, when a National Service Committee of nine members was created. The members are distributed among several societies and located in many parts of the country, but the chairman is the Washington representative of Engineering Council and in charge of an office opened in January in the McLachlen Building, at Tenth and G streets.

The National Service Committee is to deal with matters of national legislation and work of the federal departments referred to it by Engineering Council. It will also maintain an information bureau for engineers, to answer inquiries regarding the reports and activities of the departments and matters before Congress. The following announcement (May 1) has just been issued:

ENGINEERING COUNCIL ANNOUNCES

a National Legislative and Departmental Information Service

for Engineers in All Branches of the Profession.

This service has been placed under engineering direction, so that responses to inquiries will be specific and suitable for engineering use. Engineering Council has established this service in response to frequent expressions of need. Its continuance will depend largely on its use by the engineers of the country. No charge will be made for such services as the committee can render.

The Statistical, Research and Construction bureaus of the Government have become valuable sources of engineering information, but have not been used by engineers to the extent merited by the character of their material. Many matters before Congress involve engineering considerations, of which members of the profession should be aware.

Set forth in specific language the kind of information wanted.

Address the National Service Committee, M. O. Leighton, chairman, 502 McLachlen Building, Washington, D. C.

LIBRARY NOTES.

Recent Additions to the Library.

U. S. Government Reports.

Abstracts of Current Decisions on Mines and Mining, May to September, 1918. J. W. Thompson.

Accidents at Metallurgical Works in United States during Calendar Year 1917. Albert H. Fay.

Canning River Region, Northern Alaska. Ernest deK. Leffingwell.

Cobalt, Molybdenum, Nickel, Titanium, Tungsten, Radium, Uranium, and Vanadium in 1916. Frank L. Hess.

Contributions to Economic Geology, 1917: Part II. — Mineral Fuels. David White.

Contributions to Economic Geology, 1918: Part I. — Metals and Nonmetals except Fuels. F. L. Ransome and others.

Evening and Part-Time Schools in Textile Industry of Southern States. Federal Board for Vocational Education. 1919.

Farm Woodlands and the War. Henry S. Graves.

Geology and Ore Deposits of Tintic Mining District, Utah. Waldemar Lindgren and G. F. Loughlin.

(The) Gold Situation: Report of Joint Committee appointed from Bureau of Mines and Geological Survey.

National Lumber and Forest Policy. Henry S. Graves.

Natural Gas in 1916. John D. Northrop.

Natural-Gas Gasoline in 1917. John D. Northrop.

Notes on Lignite: Its Characteristics and Utilization. S. M. Darling.

Occupations in Navy Yards. Federal Board for Vocational Education. 1919.

Oil and Gas Geology of Birch Creek–Sun River Area, Northwestern Montana. Eugene Stebinger.

Our Mineral Supplies: Quicksilver. F. L. Ransome.

Results of Magnetic Observations Made by United States Coast and Geodetic Survey in 1918. Daniel L. Hazard.

Traps for Saving Gas at Oil Wells. W. R. Hamilton.

Water-Supply Paper 427: Bibliography and Index of Publi-

cations of United States Geological Survey relating to Ground Water. Oscar E. Meinzer.

State Reports.

New York. Annual Report of Public Service Commission for First District for 1917, Vol. I.

New York. Annual Report of State Engineer and Surveyor for 1916–17, 2 vols.

City and Town Reports.

Boston, Mass. The North End: Survey and Comprehensive Plan: Report of City Planning Board.

Brookline, Mass. Report of Town Engineer for 1918.

Concord, N. H. Annual Report of Water Commissioners for 1918.

Fall River, Mass. Annual Report of City Engineer for 1918.

Haverhill, Mass. Annual Report of Water Commissioners for 1918.

Northampton, Mass. Annual Report of Water Commissioners for 1918.

St. Paul, Minn. Annual Report of Water Commissioners for 1918.

Springfield, Mass. Annual Report of Water Commissioners for 1918.

Taunton, Mass. Annual Report of Water Commissioners for 1918.

Waltham, Mass. Annual Reports of All Departments for 1918, including First Annual Report of City Manager.

Waltham, Mass. Annual Reports of Street, Engineering, Water and Sewer Departments and Board of Survey for 1918.

Wellesley, Mass. Annual Reports of Water and Municipal Light Commissioners for 1918.

Woonsocket, R. I. Annual Report of Water Commissioners for 1918.

LIBRARY COMMITTEE.

Vol. VI JUNE, 1919 No. 6

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

THE MOVEMENT TO ESTABLISH A NATIONAL DEPARTMENT OF PUBLIC WORKS.

BY FREDERIC H. FAY,* PAST PRESIDENT BOSTON SOCIETY OF CIVIL ENGINEERS.

(Presented May 21, 1919.)

MR. PRESIDENT, FELLOW MEMBERS AND MEMBERS OF THE BOSTON SECTION OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, — The representative of the Boston Society of Civil Engineers is very glad of this opportunity to make his official report as the delegate of the Society to the conference in Chicago, called by the Engineering Council, to consider the movement for the establishment of a National Department of Public Works.

For over forty years the engineering profession has discussed the desirability of a National Department of Public Works manned by a permanent body of civilian engineers. So far, discussion has been abstract rather than concrete, and has failed to produce results. But the movement has gained strength at each recurrent period. The idea will not down; it is fundamentally right, and if carried out it will be of great benefit to

[NOTE. — This meeting was in the nature of a symposium presided over by Leonard Metcalf, President of the Society, and joined in by the Boston Section of the American Society of Mechanical Engineers. Further discussion is invited, to be received by W. L. Butcher, Editor, before September 10, 1919, for publication in a subsequent issue of the JOURNAL.]

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the country. It is bound to succeed in time, but success will be reached only by crystallizing the idea in a congressional bill and enlisting in support of the bill the strongest kind of coördinated and coöperative effort.

A glimpse of the situation that exists to-day is given by Mr. J. Parke Channing, chairman of Engineering Council, in his opening address at the recent Chicago conference:

"Our Government has become the greatest industrial plant in all history, — investigating, surveying, building and operating, — and its various functions are being conducted with practical independence one with another, and with so little coördination and so complete a lack of common purpose that practically the only occasions when the various elements become conscious of each other is when they overlap and attempt to crowd each other off the map; that any private or corporate business conducted according to the methods of Government would speedily become bankrupt and would deserve such fate. There are twelve federal organizations engaged in making surveys, more than a score in chemical investigations, some of them competing and quarreling for preference under the same departmental roof. In the Congressional Directory there are listed twenty-nine bureaus and agencies of Government engaged in construction of one or another kind. Four Government departments are engaged in fuel tests, while four Government bureaus are maintaining coast fleets each independent of the other, in the same waters, and engaged in work that has so many points of contact that not one person in twenty realizes that they are separate. These are only a few illustrations of a condition which can be tolerated by no considerate person."

There is another argument, and a very sound one, in favor of establishing a National Department of Public Works, and that is the prospect of establishing a national budget system. The budget system is the only system under which an efficient administration of the financial affairs of a government can be obtained. The United States is the only country in the whole world, claiming to have a modern government, which does not make use of the budget system.

The unification of the engineering and construction activities of the Government in a single Department of Public Works would logically carry with it the introduction of modern budget

methods, at least so far as the activities of that department were concerned. In place of present congressional authorization by log-rolling methods, budgets could be carefully studied by the department and various projects considered in advance on their merits and in their relation to one another, so that in passing legislation concerning the department Congress could act with full knowledge of the facts. Legislation creating the Department of Public Works should provide for such departmental investigation before congressional action. In short, here is the opportunity to introduce modern business methods in one of the most important fields of Federal governmental activity.

The advantages to be gained by the country at large, through a National Department of Public Works are economical. First, there is the saving resulting from consolidation, due to the elimination of the present duplication and overlapping of activities in the various departments and bureaus. It is not expected that if the department is created it will mean at the start a radical reorganization of the various bureaus now conducting governmental engineering construction work, but that by bringing these bureaus together and by proceeding in a process of orderly development, by seeing that no two bureaus are trying to do the same work, and by the gradual process of evolution, there will be effected a very large and substantial saving in the cost of operating such a department. Second, great savings are possible by doing away with the "pork barrel" and adopting a policy of carrying out public works according to predetermined, well-studied and coördinated plans. The net result to the country, if this project is carried out, will be more value received for each dollar spent in the public works.

Incidentally there are possibilities of great benefits to the engineering and architectural profession by backing and putting through this movement. In the first place, there will be wider recognition, by the public, of the dignity and importance of governmental engineering work — and the word "engineering" is here used in its broadest sense. Successful administration of the department by an engineering personnel will add to the prestige of the engineer and architect. More general recognition of the worth of engineering service, with the consequent improve-

ment of the status of the engineer in government employ, will, we believe, be the outcome. At the present time many of the bureaus with engineering duties, conducting engineering or construction work, are so minor in the departments in which they are placed that they are greatly hampered in their activities and do not receive the appreciation and recognition justly due them. The combining of all under one head — and that head a Cabinet member who is himself trained in engineering and construction work, as contemplated also by this bill — will result in a great improvement in the status of the engineer in governmental service.

The time is ripe for action. In this period of readjustment following the war the public mind is turned towards problems of reconstruction and reorganization in all fields of activities, private and governmental. Shortcomings of existing machinery of the National Government have been laid bare by stress of war. Congress is alive to the necessity for changes and improvements, and at this present session much time will be spent in a consideration of problems of reorganization of the governmental activities. The congressional mind is now receptive to sound and meritorious suggestions.

The engineer has played an important part in winning the war and has done his work well. As a result of the war the engineering profession has taken an immense forward stride in the public estimation. Now that the war is won there is open to the engineering profession an even greater opportunity for service in peace time in participating in the reorganization and readjustment of our national affairs. The public mind to-day is receptive to and awaits sound constructive suggestion. With the new prestige which the engineering profession has attained, a meritorious proposition like this, with a solid engineering backing, has bright prospects of success.

The present movement for a National Department of Public Works was started by Engineering Council during the past winter.

Engineering Council, as you know, is an organization representing the four national societies of civil, mechanical, mining, and electrical engineers, and more recently the American Society

for Testing Materials. Engineering Council has recently set up a committee known as the "National Service Committee," with headquarters in Washington; with permanent office and personnel; with the object of serving engineers by giving them information regarding governmental activities and getting for them data which may be desired from the files in the archives in Washington. But the chief work of the National Service Committee of the Engineering Council is the furthering of this project for a National Department of Public Works. After passing resolutions, this winter, endorsing the project, Engineering Council sent out invitations to engineering and architectural societies throughout the country, and to certain contractors' organizations, asking them to send representatives to a conference to be held in Chicago, April 23–25. This conference was broadly representative of the professional organizations of the entire country. The attendance included 71 delegates representing 74 engineering, architectural and contracting organizations, and in addition there were present 7 members of Engineering Council and 3 members of the National Service Committee of Engineering Council, who were given the privilege of the floor, but without the right to vote. The delegates came from all over the country, — San Francisco on the west, Duluth on the north, New Orleans on the south and Boston on the east, and from places all the way between. The convention of three days was held in the rooms of the Western Society of Engineers, and that society extended most generous hospitality. The convention was given every facility of the society quarters and on one evening the delegates were entertained at a banquet at the Chicago Athletic Club.

The convention was called to order, on the morning of the first day, by Mr. J. Parke Channing, chairman of Engineering Council, who briefly outlined the purpose of the conference and the general reasons why engineers urge the formation of a federal Department of Public Works, and he made it clear that Engineering Council was merely the agency through which the conference had been called together and that Council had no desire to be a determining factor in the conclusions reached.

Organization was effected by the election of Mr. M. O. Leighton, chairman of the National Service Committee, as chair-

man of the convention, and Mr. E. S. Nethercutt, secretary of the Western Society of Civil Engineers, as secretary of the convention.

From the outset the delegates were unanimous in the belief in the desirability of a National Department of Public Works. As soon as organization was effected, the time of the first session was given to a consideration of the general project and to the underlying principles of such a department. General sentiment was in favor of including only those services and bureaus whose work is chiefly of an engineering character. Differentiation was also made between engineering work of a military and of a civil character. The result of this morning's discussion was embodied in the following resolution:

"This conference of the delegates from engineering and related organizations respectfully recommends to the public and to the Congress, that legislation be enacted covering the following principles:

"1. That the services and bureaus of the National Government, having to do chiefly with matters of engineering and architecture, be grouped in one department to be known as the Department of Public Works.

"2. That the Department of Public Works comprise those works which are built and operated for the use of the public.

"3. That the Department of Public Works be made available when desirable for the performance of special engineering and architectural work for the use of other Government bureaus.

"4. That there be a systematic classification and organization of engineers, architects and other employees whose status shall be such that they may be recruited and maintained on merit."

Having adopted these general principles, the afternoon session of the first day of the conference was devoted to —

(*a*) The federal bureaus or activities which should be included in a Department of Public Works.

(*b*) Whether the effort should be made to secure an additional cabinet office or make over one of the present departments by redistribution of activities.

(*c*) Whether the present effort shall be to reorganize engineering bureaus completely, or merely to bring such bureaus under a single head, so that such rearrangement of functions as

is found desirable may be made gradually and as a result of experience and mutual deliberation.

As a result of this discussion the Committee on Government Engineering Activities brought in next day the following report, which was unanimously adopted:

"Your committee charged with a consideration of the question which Government activities should be coördinated in a National Department of Public Works, recommends:

"1. That the establishment of a National Department of Public Works should be accomplished by grouping those Government bureaus, services, commissions and other activities whose functions are predominately of an engineering or architectural character, in what is now the Department of the Interior, and thereafter designating that department 'The Department of Public Works.'

"2. That the transfer of any bureau, service or commission from any other department to a Department of Public Works should be accomplished without change of personnel, compensation and general plan of organization, leaving the coördination of the several activities, the simplification of organization and the establishment of additional bureaus, such for example as a bureau of chemical engineering, to be effected as the need for the same may from time to time become apparent.

"3. That in transferring river and harbor work and other work non-military in character, but now in charge of the Engineer Corps of the United States Army, to a Department of Public Works, the relation of the army engineers to such work be not changed and that there should be no relinquishment of non-military duty by the army engineers now on such duty until transfer of these engineers to military duty can be made without detriment to the public interests.

"Your committee finds that among the bureaus, services and activities, which logically belong to a Department of Public Works, are the following:

A Bureau of Public Roads.
The United States Reclamation Service.
The Alaskan Engineering Commission.
The Construction Division of the U. S. Army.
A Bureau of River, Harbor and Canal Work, including such functions as are now exercised by the Mississippi River Commission and the California Débris Commission.
A Bureau of Architecture.

A Bureau of Surveys, including the Coast and Geodetic Survey.
A Bureau of Mines.
The Geological Survey.
The Forest Service — at least until the same is divorced from the supervision of water-powers and road building.
The Bureau of Standards.

"Your committee believes that it would be unwise to determine at this time to what extent the proposed Department of Public Works should control the engineering activities of the General Land Office; of the National Park Service; of the Bureau of Lighthouses, of the Bureau of Indian Affairs, and of the Public Health Service and of various commissions, such as Commissions on Buildings and Grounds, and therefore suggests that such matters may well be deferred for consideration to a later date, preferably until the department has been organized."

Considerable time was then given to the means to be employed in pushing legislation and in financing the campaign. The necessity for permanent organization was evident, and such organization was effected by the conference in the following resolution:

"*Resolved*, that this conference be known as the ENGINEERS, ARCHITECTS AND CONSTRUCTORS CONFERENCE ON NATIONAL PUBLIC WORKS; that it continue in existence until dissolved by its own action, and that its officers and committees be empowered to further the organization and development of a National Department of Public Works."

Having passed this resolution providing for permanent organization, the conference then adopted as its machinery of permanent organization three committees, as follows:

1. An executive committee which was empowered to appoint a finance committee and also to add to its own membership and to the membership of other committees;

2. A committee on the text of bill, to which is entrusted the duty of drafting the bill which shall be introduced into Congress, as soon as possible in the present special session; and

3. A campaign committee.

The campaign committee is charged with the duty of giving publicity to the movement, — of pushing it in all parts of the

country, enlisting the support of as many organizations and agencies as may be obtained, and generally seeing to it that the campaign is properly organized and is pushed in an effective, systematic and well coördinated manner.

In this locality we have certain work to do. In the first place, we must conduct a campaign of education of the public and especially of members of Congress. We must organize local subcommittees of the campaign committee, in all parts of each New England state. The papers in the home town of every New England congressman should be filled with more or less information regarding the Public Works Department, and suitable editorials should be published regarding it. We must stimulate public interest through enlisting the active and hearty support of engineering and architectural societies, contracting and building organizations, Chambers of Commerce, the Associated Industries of Massachusetts, Rotary Clubs, and many other organizations. We must gain publicity for the movement through press notices about the bill; through meetings to be held; and through editorial comment. Ammunition in the form of material for argument and discussion of the bill will be supplied through the central committee at Washington, whose headquarters will be that of the National Service Committee of Engineering Council, in the McLachlen Building, Tenth and G Streets, N. W. It may be said here that Mr. Leighton, chairman of the National Service Committee, is also chairman of the Executive Committee and chairman *ex officio* of each of the other two committees, — so that he will be the effective head of the whole movement.

Engineering and architectural organizations need not expect to put this movement through by their own unaided efforts; rather, they must be the leaven to start a movement which through obvious merit and soundness will spread throughout the country.

The opportunity is now before us professional men to be of inestimable service to the public at large, and, by rendering this service to add to the prestige of our profession. If we can rise to this opportunity which is now given us, get beyond the technicalities of our professional work and look to the needs of

the country as we see them, and exercise our special knowledge and training and abilities, solving the particular problems which now are awaiting solution in governmental activities, we can put the engineering profession far ahead of its present status in the public mind; we shall prove that the engineer can, in the broadest sense, be of real service to the country. At the same time this will do more than anything else to enhance the importance of the engineer and secure for him the recognition which he deserves.

DISCUSSION.

Dr. Ira N. Hollis.* — I am very glad to say a word in continuance of what Mr. Fay has said to you. I find it rather difficult to get to meetings of the Boston Society of Civil Engineers, of which I am proud to be a member and prouder still to have been a past-president. But Worcester is my problem now, and one which has kept me so closely at work for the past three or four months that I am lucky to be able to leave to-day.

We have established a bureau for returned soldiers and sailors there. I have gone into everything of that nature, because I think engineers ought to be represented in public work of any kind, and this bureau has given me a satisfaction such as I could not have found in anything else, as I see these boys coming back from the other side. I have found not only pleasure but some amusement in the work, and some insight into the working of the minds of engineers who have come back from France. I am going to digress a little in order to tell you my very first experience in the employment of returning soldiers, sailors and war-workers. In the beginning it was called a bureau for all three of these. I think that when the Department of Labor put in the word "war-workers" the officials little knew the consequence, because a great many people are called war-workers who gave up their jobs in order to do government work at very much higher wages, and they came to claim privileges on that account. The first who presented herself was a woman who had ceased to be a war-worker. She told me she wanted to get back into her old position. When I asked her what that was

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she said, why, she had been a cook. She had gone into the American Steel and Wire Company because she could get four times the wages there that she had received as cook. I asked where she used to work. She said, "11 Boynton Street." "Why," I said, "that is my house." "Yes," she said; "I used to be your cook." I told her that I would see about getting her back on the job, but I felt entirely cured of anxiety for war-workers.

We have much to go through during the next few years, in getting back to our work. Hundreds of men have come to the city of Worcester at exactly the same time, wanting to get back on the old jobs, when either the old job had disappeared or the organization necessary to run it had gone.

There is a certain side of the returned soldier and sailor which we ought to consider and bring to the attention of employers everywhere. We must have patience, especially with boys who have been across the ocean and are now passing through a period of reaction. Many employers in Worcester have said to me, "The men are not good for anything. They don't want to work." I think hundreds of them are half asleep, — in a state of disgust and weariness from what they have been through on the battleline. Now, we have thousands of these men coming back, and because they are loath to go to work immediately is no sign that they will not be good in the future. Consequently I have appealed to manufacturers to have patience with these men until they settle down.

I went West with the same hesitation because I had other things to do — but I certainly got some profit from that meeting in Chicago. I believe that the engineers of this country will eventually assist in what is known as the budget system in Washington, and perhaps have a strong influence in bringing the country out of that chaotic state we have been familiar with during the past two years. I therefore approach this subject of the establishment of a National Department of Public Works with an absolute conviction that it must be carried through. There may be obstacles on account of the fact that whenever a Government bureau is formed, every man in it holds on to his position as his birthright, and we certainly shall find great diffi-

culty in breaking up the vested rights of an outworn political system and in adjusting ourselves to conditions that now prevail in Washington. It may be a good many years before the project is put through. I hope not. Nevertheless I have full belief that it is an absolutely necessary change in our administration in Washington, and in the business of carrying on public works of all kinds. In spite of the intense opposition which I feel sure we shall meet in putting some Government work — for instance, the rivers and harbors — under civilian direction, we must nevertheless fight it out for the good of this country and for the good of the civilian engineer.

It has seemed to me, however, that there is something that must precede the formation of a Department of Public Works, and that is the better organization of the engineers in the United States. Have we gone far enough with that? I have watched during the past three years, with a great deal of interest, the formation of committees of all kinds, made up of men principally from the four larger societies, and the organization of many new societies. The difference of opinion that has seemed to exist strikes me at times as creating an impossible situation for the engineer. In other words, we've got to learn to work together better than we have in the past.

There was formed about three years ago — and I had some hand in it — a committee on standardization. We had in the American Society of Mechanical Engineers a very good standardization committee. The Electrical Engineers, the Civil and the Locomotive Engineers, all had similar committees, — all good standardization committees, — and yet when we attempted to select some members from each one and fuse them together into one great standardization committee for the United States, to take care of that which is vital to all commercial life and vital to trade at large, we found no end of difficulty and misunderstanding. They have spent three years in talking over organization, because there are so many points of difference in their ideas as to the way the thing ought to be done and the way the various engineers can be brought together. I do not believe, however, that there is any real difference. They all recognize well enough that they belong to a great profession upon which the prosperity

of this country is absolutely dependent, yet nothing great has been accomplished. Why? Because, the societies have not worked together.

I repeated here some years ago a remark made by President Eliot before I left Harvard. In a conversation about the tariff system of the United States he said, "The tariff must eventually be determined by engineers." I firmly believe that it is true. Now, it has seemed to me that in connection with our country and the development of things in our professions, each individual society has a field of its own which probably will never disappear. I take the view that I can fairly represent here to-night the American Society of Mechanical Engineers. What was it founded for? It was founded as an educational society to enable its members to perform their service better. That is the fundamental purpose of each one of these national societies. The civil engineers have had the best of this for the simple reason that they have less of the commercial element, as they have represented to a greater extent than the other societies the public works of the country. There is very little of the commercial in it, so far as the papers which have been read. Nevertheless, every one of these societies is fundamentally an educational society for the training of its own members to do better work, and to inform them of what is going on in their own particular branch of the profession. I hope that will never be departed from, for it would be a mistake to lose that element.

Is there room for something more? I asked those in the office in New York to give me a survey of the activities of the American Society of Mechanical Engineers during its history. This was too large an order, but they have worked out a résumé of the activities of the society for the past ten years and have gone into considerable detail as to the number of papers on technical subjects, general subjects, and public welfare. I should say from an analysis of the activities of the society that we have lost practically nothing during this progressive period in the educational features of the society. The papers are quite as good as anything we have ever done before, — perhaps not quite so fresh, but it is difficult to get anything fresh now. Nevertheless, carrying through all this time, the same educational feature

is apparent. That study has convinced me that there is room in the United States for a better consideration of public questions generally, in which all engineers ought to take part. There are no social problems that do not affect civil, mining, mechanical and other engineers. What is the organization which will enable us as engineers and professional men to take over those activities that do not naturally belong to the educational engineering association? I think the Engineering Council opens the way to something better. It was planned and started several years ago under the four large societies, and this with great difficulty. I was present at all the meetings and heard the discussions, and the best we could do was to settle upon by-laws for the consideration of questions referred to the Council by one of the founder societies. The decisions had to be unanimous and in many cases referred back for approval by every governing board. It was all a compromise, leaving much to be desired. At present it is too circumscribed, yet the experience has convinced me that all societies and engineers may be brought together in some kind of a senate, council or united society for all public and for some technical questions. We started in the Engineering Council by specifying that only national societies should be admitted to membership, and every member should be approved by the founders, thus keeping the control entirely in the hands of the four original societies, — but just recently a resolution has been proposed that the word " national " be struck out and that local societies be eligible, the Boston Society of Civil Engineers as well. It was a shock to me to have a set of by-laws approved by that association that would overlook one of the oldest and best organizations in America simply because it had the word " Boston " before it.

We have taken this step so that if the recommendation is accepted within a year we shall have it in our power to call to the Council the local societies all over the United States, thus bringing together the same kind of coördination as was found at the Chicago conference.

I was not a member of the conference when I went to Chicago and therefore had no vote and little right to talk, but I enjoyed listening. I felt a great deal encouraged by this movement

toward better organization for promoting efforts of a public nature. I am not speaking of the educational feature which belongs to every member society. I would not take from any society its characteristics, but rather join them all so that we may act together and iron out our differences before we put up any proposition to the central government of the United States. Any proposal to establish a Department of Public Works, which is not backed by the confidence that results from complete coöperation to our full strength, is doomed to failure.

We can accomplish nothing unless we work together. This leads me to say one other thing,—about another feature of this subject on which I have been thinking a great deal. Two years ago or more, when I was president of the American Society of Mechanical Engineers, I started out to talk to the engineers and the Chambers of Commerce in every big city of the United States. I did not succeed in accomplishing this. I did, however, go around the entire border of the country, visiting every large city and some of the central cities. I talked to engineers on the subject of organization; and I found this the general sentiment. Local problems and conditions should be the work of local societies of engineers who might even take up legislative and state or city matters. I thoroughly approve of this. The only undesirable feature is that we do not want half a dozen branches dealing separately with miscellaneous questions of public interest. We should all work together and produce what we have had in Boston recently, namely, the meeting together of the engineers representing all branches. I have been thinking why should not Boston — which is preëminent in many ways — form a stronger organization of engineers? We have one of the oldest engineering societies here,— one which represents the best in America. As I come from Kentucky that is fairly an unprejudiced view. Why should not this Society take the lead in the formation of a stronger and better engineering organization for all the engineers of New England? I firmly believe that we ought to do that as the best means of making ourselves felt. I know a great deal of nonsense is talked about the engineers, and we all know it; nevertheless, behind it is a real brotherhood of the engineer, which ought to bring us together in this Society, not as the

Boston Society of Civil Engineers — which I think has too narrow a name — but in the New England Society of Engineers. I have never brought that up before the Board of Government, because I might hesitate myself, if I were now on the Board of Government, to change the name of a society which has done so well for more than fifty years. I believe that the experience in that meeting in Chicago points to better organization in all the localities in the United States, so that we may unite behind a movement that can never succeed unless we do coöperate. That is what I want to bring here to-night, mainly to supplement what Mr. Fay has stated so admirably here. We can never succeed in anything unless we find some way by which we can speak as a unit. Could we have done that years ago? Not a bit of it, gentlemen. We opened the Engineering Building in New York with a division at the very start. That gap has closed, and at least four of the greatest of our engineering societies are now together under one roof, working together. They say the civil engineers are not on the foundation, but they are on the roof. That is the finest location of all. They may have done well to wait.

My belief and my statement I am going to reiterate. The only hope of establishing a Department of Public Works, which I believe to be an absolute necessity to the future prosperity of this country, lies in organization; and the only way that organization can be made is in the same way that our government was formed. The strength of America to-day lies in its local self-government, joined behind the great federal system. We know that perfectly well. That without the state of Massachusetts this Union would be poor, and many of the elements in it now would be lacking. Without other states our country would be poor. The day its local self-government departs, that day the Republic is in danger. I feel, then, that the engineer has and should have the opportunity for the same kind of organization that has made our country so great, and such a great power in Paris during this discussion. Whatever we may believe about the League of Nations, — whatever we may believe about certain things that have been going on in the last three or four months, — no American can help feeling intense pride

that everything in Europe seems to revolve about the American delegation, and I believe local self-government has pushed America into the finest thing in the world.

One last thing, — the formation of a strong central council does not take one whit from the educational value of our individual societies, national or local.

I want to add that it has been a great pleasure to come up here to-night. I have seen many faces that recall old friends and old times. They seem all the more like old friends as I become more distant from them. I am very glad to come back and salute you, my friends.

WALTER B. SNOW.*— I have in my hand a draft of the report of the Committee on Aims and Organization, which is merely a progress report and by no means complete. You of the Civil Engineers have a Committee on Development, and the Electrical and Mining Engineers somewhat similar organizations. We in the Mechanical Engineers have this Committee on Aims and Organization, and those of us who had the pleasure and good fortune to attend the Wernersville conference — where we had a two days' meeting of twenty-five members of the committee, from all parts of the United States — all found in it a great inspiration, primarily because of the unity of purpose displayed. We were divided into three committees, covering various aspects of our aims and organization, and met three times a day; in the morning and afternoon as individual committees, and in the evening as a joint committee. All of the questions brought before that committee were approved subject to editorial revision, and turned over to the editing committee whose report I have here in my hand.

It is very easy for a committee like ours to do what everybody quite naturally expects them to do, — pull something to pieces. It was therefore a great pleasure to find such unanimity of desire to make all our work constructive, and to stop at the point where we began to touch the *manner* of doing a thing — or, in other words, where we began to attack present methods. A good many things we touched upon were purely local in that

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they belonged to the American Society of Mechanical Engineers only, but others were of vitally mutual importance. I believe that right here in Boston the various sections and engineering interests can either keep separate and fail to accomplish the things we ought to accomplish or get together and do some great work.

A consideration of the broader aspects looking toward the advancement of the engineering profession as it concerned us in the progress of civilization brought out the necessity of research and the specific adoption of engineering standards. It was our idea that such standards might be considered as progressive and not as ultimate; and it was specifically recommended that industrial engineering be considered as a major subject for discussion at our meetings. The greater coöperation of technical societies was advocated in matters of education along different lines of engineering. This properly concerns the mechanical more than it does the other classes of engineers, particularly as regards the development of the proper type of helpful education for the subordinate of the engineer. Many of us have keenly realized the dearth of such education when we needed trained superintendents and foremen. The publications of the American Society of Mechanical Engineers are to be advanced; made broader in their scope and of more service, we hope, to the mechanical engineering fraternity at large.

One subcommittee had to do primarily with the relation of the mechanical engineer to the community, which brings us home to the vital question of the tie that will bind us in any coöperative effort. Discussion brought out very strongly that there is no use talking of what the society or a little group will do; we have got to see what the individual will do. When he does his duty as an individual we can rest secure that his section or local society will do its duty. In order to avoid confusion it was determined to distinguish between technical societies and what might be called general engineering societies, and to go far enough in the fostering of engineering solidarity to secure for the consideration of our Society the organization between local and national, through such bodies as might be developed. We did not advocate any changes in names or

any exact methods by which this should be accomplished, but did recommend that a study be made and the results published, which would present the methods adopted in different centers for bringing together the various engineering interests in one society. There are some very interesting types throughout the United States in individual states. All centered upon the thought that there should be created some agency of national character, through which coöperation between local societies could be secured for purposes of national scope, such as discussions of legislation, public works, public health and administration. Discussion of industrial relations brought out very properly that the engineer on the production and commercial side is perhaps as intimately connected with the whole industrial problem with which is concerned the labor question as is any man, and when he looks at it as he does at other questions we may hope for a sane and honest solution of the problem.

I might run on to other details, but have endeavored merely to show the lines on which we have been working and thinking, and to tell you that this report will be presented in just about a month at the Detroit meeting of the Society. How it will be received and what discussion it will provoke, remains to be seen. You can rest assured it was made with the purpose of stimulating discussion and that it is distinctly constructive in every way.

Calvin W. Rice.*— I am very grateful to Professor Hollis, your past president and honorary member, for the splendid way in which he has suggested the coöperative idea for Boston. The tour of the United States that he made three years ago, visiting the sections of the American Society of Mechanical Engineers, is still being talked of in those sections as the event of their history. The high plane on which he spoke was an inspiration to them. It has been my privilege this year to make the same trip. To-night in Boston I complete a circuit this year made of every principal city in the United States.

The one great thing which Mr. Fay has emphasized, is the complete organization which must be made in order to put through a National Department of Public Works. I hope

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you grasp the import of what this organization means. Dr. Hollis urged that we do not undertake this by separate societies or by the separate sections of any society. We must all pull together. We must secure the cöoperation of the architects and the chemists and the geologists or other professional men in those sections of the United States where they are sufficiently numerous. We've essayed to go immediately to Washington and open an office and put a big movement right through the National Government. In very few cities and districts of the United States have we had any practice in handling movements where we have had to move the public will. Therefore the logic of the situation is that we must first learn how in our own homes. The uniform gospel I have been preaching through the United States, with one or two exceptions, so far as I can observe, is working one hundred per cent. I have no doubt about the few places where they are hesitating. The message is that every professional man, including the architect and chemist, should be a member of the local engineering society of his home. As he progresses in his professional and financial attainments, he then becomes a member of that national body of his specialty. The more loyal and effective he is in his local society, the presumption is the more effective he will be in his national relationship. As to the organization, — in each city my first preference is that the local society have on its board one or two men representing each of these groups of the professions. Those men should be elected by the groups in distinction from the membership at large. In that way you will give a representative character to the board. Where not desirable or not practicable to alter the existing by-laws and constitution in order to permit of this broadening of its board and the election of members by the several groups, then the other alternative is to have a joint engineering council or board.

In Philadelphia, St. Louis and Milwaukee, you will find societies that are formed along the first suggested method, — particularly in Philadelphia, where there are seven different organizations represented on the board. The other types you will find in Atlanta, Los Angeles, San Francisco, Spokane and the Minnesota joint engineering board. In the last-mentioned

places, instead of the local society being the center about which the other societies group themselves, the local society has the same representation on the joint board as other societies, or local sections of national societies. Here in Boston you have the choice; and before you can undertake to effectively put through the proposition which Mr. Fay has so ably stated it is essential that Boston have one of the two types of organization so that we can get together. Having organized as suggested, the primary object must be public service. All of you who go to New York ought to see the extraordinary exhibition of the Roosevelt trophies, on exhibition, I believe, till June 10. As you go in you will see statements characteristic of President Roosevelt. One is, "Every man who thinks well of his country will take part in public life." Not any in this room will deny thinking well of their country, but very few take part in public life. Several ways that Mr. Fay has pointed out are open to us, and we must undertake them, and, as Dr. Hollis and also Mr. Starkweather have stated, it is probably certain that the engineer will advance in his profession in proportion as he renders service, and service means to the public good. I want to draw your attention to the address of President Kimball of the American Institute of Architects at the Nashville convention two weeks ago. He carries the idea still further, to include all of the professions as men apart from other callings. We may not practice our professions — medicine, law, engineering, architecture, painting, etc. — for the love even of our profession; we must practice our professions for the benefit which that service will render to humanity. If you carry that to a logical conclusion you will arrive, with Mr. Kimball, at the inclusion of all the professions in one common brotherhood. This is all in keeping with the topic of engineering, and I have never been more impressed with the idealism that exists in this country at this time than I am now by this movement of the engineers to put through the project of a National Department of Public Works.

At the meeting in Chicago, seventy-four societies were represented officially by delegates. It is the first time that any such organization of the profession has ever been effected.

The organization was authorized to continue in existence so long as it is necessary. They will see so many more things to do that they will keep a permanent organization. You all know that there is another organization in the United States at work practically to do the same thing, and you will find in *Engineering and Contracting*, I think for May 15, the suggestion in the editorial pages that what we have done in Chicago is competing with this other national body, and the suggestion is further thrown out that we won't do it as well. With all the idealism that has been suggested, I want you to get right down to earth on real principles. At Seattle to-day the draftsmen are members of the union affiliated with the American Federation of Labor. Every draftsman in Seattle is getting ten dollars per day; you will find certain of the school teachers of the City of New York, Salt Lake City and other cities, are members of a union affiliated with the American Federation of Labor. Now we are getting right down to business. With our idealism we have started in Chicago an organization of the engineering profession. We must form such organizations with ideals, and attract young men to them, otherwise they will drift into the type of organization where selfish motives, wages are the principal object. I want to start, if I can, in every city of the United States, a movement toward coöperation for the attainment of the higher ideals of the profession. In the mails yesterday I received letters from Denver where I spoke before a group of architects, chemists and other men. I had a letter from Mr. Ridgeway, president of the Colorado Joint Engineering Council, and Mr. Carpenter, brother of Professor Carpenter, of the Civil and Commerce Association of the city. And so on throughout the United States we are getting these bodies formed, and I hope we can get together here in Boston on some basis which will bring in all the engineers, architects and chemists and other technical professional men.

We must make the fundamental motive of all of our professional societies, in addition to the educational feature, the service of the community in which we live as citizens, for the public good.

LEONARD METCALF.* — The hour is rather late, gentlemen. I do not want to speak to you at length, but in the interest of broadening the scope of the admirable remarks which have been made to-night on this movement looking toward the establishment of a National Department of Public Works, there is one phase which I should like to bring to your attention, namely, the question of civil *versus* military control of the National Department of Public Works. I can do so in a very few words.

The situation must be faced frankly that the Engineer Corps may take the view that it could function well in this matter; that it has already done a very large amount of the public-works construction of this country; and that it certainly has a splendid reputation for accountability, in our Congress. Nevertheless, it would be unfortunate to have the public works of this country generally under the control of the military branch of the Government.

There are fundamental reasons for desiring civilian rather than military control of our public works, which in no wise detract from the honor of that able and distinguished body of engineers, — the Engineer Corps of the United States Army.

The undesirability of developing an all-powerful military autocracy or bureaucracy — the ultimate goal of which is avowedly fitness for war, the training of which is essentially military, and the development of which must be under military dominance and promotion by seniority rather than for professional and commercial ability developed under competitive struggle — is obvious.

This training, necessary for command and efficiency of coöperation at the front, tends to stifle the individual effort of the young engineer. Who does not know the discouragement of pigeonholed reports and transfer from post to post, thus denying to the young engineer the stimulating effect of seeing the realization of his hopes and work?

Army officers returning from the front are finding it difficult to adapt themselves to the present outlook in the War Department. The outlook is very uncertain. There are many prob-

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lems of organization in the new army to be met, but the whole machinery is awaiting the President. The past attitude of the Secretary of War upon the subject of universal military training in this country has not been such as to encourage one to believe that much progress will be made in this direction, at least under the present administration. Indications point to the fact that Congress may approach army reorganization from a partisan and personal rather than national standpoint.

The War Department itself has not been able to outline a definite policy acceptable to all branches of the service, due, in part, no doubt, to the jealousies between the bureaus and the field forces, a lack of proper coördination, and generous recognition of the essential character of the work of substantially all of the bureaus — at home as well as abroad. The great need is for a strong man, capable of leading men and unafraid of criticism, — a Roosevelt. Army men had hoped that General Pershing might come back in time to be of service in this matter, but the situation abroad has perhaps demanded his presence and it may be that there are many in this country who have preferred that he should remain at the front.

In war there are three sectors, or perhaps I should say three lines of defense, — the front line, the supply and transport behind the front lines, and the home industries converted to war use.

In the first of these, the Engineer Corps must be supreme; in the second, it may be aided effectively by civilian engineers.

Of the work in the third, it can best be relieved.

In times of peace, commercial considerations must control, and the country's needs will best be met by the utilization of existing agencies operating under commercial and industrial conditions and control.

The contrast between these two methods of organization and operation — the military and the civilian — is well indicated by the methods adopted on the one hand, by the U. S. Engineer Corps in the enlargement of its corps, by the very rapid promotion of its engineers and the drawing in of civilian engineers, generally underneath rather than among its own engineers; and, on the other hand, by the method of building up the personnel of the

Construction Division of the United States Army, which was charged with the building of the cantonments, camps, terminals, storage warehouses, etc., in the recent war.

The Construction Division was essentially a civilian organization, presided over by two very able regular army officers, — the one, Brig.-Gen. Richard C. Marshall, a graduate of the Virginia Military Institute, in command of the division; the other, Col. C. H. Hartman, in command of the Maintenance and Repair Department, a graduate of West Point, if I remember rightly. The personnel was drawn from engineers, engineering contractors and accountants the country over, from men in all walks of life, from men masters in their specialties, — specialists, if you will, — and not men whose chief interest and specialty centered on war. It is true that a number of men were taken from the Engineer Corps reserve officers' list, but all of these were civilian engineers who were members of the United States Engineer Corps only because they had recently offered their services to the Engineer Corps and were not yet needed for its special work.

The relations of the Construction Division to the large contracting firms of the country, to contractors generally, and its methods of procedure and accomplishment of work, were totally different from those of the Engineer Corps.

A similar difference is to be found between the work of the military engineer and the work of the civilian engineer in the past construction of large public works, such as by the Geological Survey or Reclamation Service of the United States, the additional water supply engineer corps of New York City, of Boston, Cincinnati and elsewhere.

The point of view of the professional engineer is quite different from that of the military engineer, and of the army officer trained to recognize every major as a major, every captain as a captain, alike in responsibility and duties, whose ability to command must be of primary consideration and whose skill in any specialty must be of secondary consideration; whereas in professional and commercial work, the ability of the individual as an engineer and administrator and the success won in his

professional work is the primary consideration bearing upon his fitness for the task.

So I say to you that the viewpoint is quite different, though the ability and accountability be alike.

Finally, in view of the objection, the just objection on the part of the public, to the development of an unnecessarily strong if not formidable military machine, it is well to weigh carefully the tremendous power which would be given to the military service by putting in its charge the general construction of all public works in this country.

I say this with an appreciation of the admirable work done by the Corps and with a knowledge that in times of peace perhaps from three quarters to seven eighths of this work has been public rather than military in its character, but with clear differentiation in the classes of service involved.

In making these observations the speaker deals essentially with the problem of administration of direction and control of a National Department of Public Works, rather than with the question of its personnel. He is not unmindful of the desirability of broadening the scope of experience of the young engineer of the United States Engineering Corps and of keeping him actively and advantageously employed during times of peace. It should be possible to do this by having these young engineers assigned to work in the Public Works Department from time to time and for certain periods, under the direction, however, of this Department rather than of the Engineer Corps. This plan would have the advantage of bringing these engineers into active competition in a sense with the civilian engineers drawn into the department work, which should have a stimulating effect upon both.

In view of the lateness of the hour I will not attempt to go further in telling you of the meeting which was held in Chicago, except to say one word in regard to the conference held on the last day, when the broad question of the affiliation of the engineering societies was discussed. It was very gratifying to see the very common feeling which existed there amongst many of the delegates; that if possible it would be well to use the agencies which have already been created, such as the

Engineering Council, — which certainly showed, in the conduct of this meeting at Chicago, its capacity for bringing together in an effective way different organizations for a common purpose, — rather than to create new agencies for doing the same work.

I want to suggest to you, too, a little different view from that which was expressed a few minutes ago by Mr. Rice, in regard to the necessity for a strong permanent organization of all of the societies, to accomplish the work which we are to undertake. I do not decry the effort — indeed, I think it commendable — to bring the various societies together in some sort of federation or organization which will give to the organization the power which comes of numbers. On the other hand, as I have reflected upon the success of that meeting in Chicago — and its success was undoubted — it has seemed to me that one of the fundamental things which made the meeting as harmonious and effective as it was, was the common interest in its underlying purpose. The men went there to discuss a specific subject in which they were interested. Upwards of 150 or 160 societies had been asked to send delegates. Seventy-four finally did so. The 74 delegates who came were interested, and effective action resulted. That suggests the thought, "Is it more effective to have a permanent organization of all of these engineering societies or professional associations, of one kind or another, which having shown its fitness for one task — having carried through some measure effectively — turns and looks for another task? The second task may not be of general interest to all who have taken a part in the first. May it not then be more effective to leave the routine work to be done by the existing organizations or associations, and call together, in some form of conference to discuss any question of particular interest, delegates from those associations which really are interested in that subject? Will you not in that way get the benefit of joint effort without having the difficulties resulting from the further multiplication of societies for accomplishing purposes which are more or less identical?

The moment that you attempt any work of this sort you face the financial problem — and it is a very difficult problem.

It is the most serious aspect of the situation to-day. The Committee of the Engineering Council is having difficulty in getting the necessary funds to carry forward its work. It is quite as great a difficulty as that of getting unity of action. It will be accomplished, of course; but time will be taken in its accomplishment. The question of organization must be viewed from different angles, and the idea that the speaker wishes to suggest is that the moment you attempt to get the force of large numbers you have to lower the standard of admission on which your engineering societies are based. The alternative is a loose form of federation which will admit societies with low standards of admission, as well as with high. For the purposes which you wish to make of that organization, the question of the standard of admission to the organization may not be one of controlling importance.

MEMOIR OF DECEASED MEMBER.

RUFUS MASON WHITTET.*

Rufus Mason Whittet, son of Alexander and Isabella (Proudfoot) Whittet, was born October 17, 1878, in Lowell, Mass., and died at Boston, Mass., on December 10, 1918. He came of Scotch ancestry, being a lineal descendant of James Whittet of Kintillo, Scotland.

He was educated in the Lowell public schools, having graduated from the Moody Grammar School in 1893, and from the Lowell High School in 1897 at the age of nineteen. Deeming it wise to further continue his academic studies, he returned the following year to the Lowell High School, taking the post-graduate course.

Mr. Whittet then passed the entrance examinations for both Harvard College and the Massachusetts Institute of Technology. Deciding in favor of Technology, he entered that institution in 1898 and graduated in June 1902, with the degree of bachelor of science in the department of Sanitary Engineering, presenting as his thesis, "A Study of the Stream Flow Records of the United States Geological Survey."

Upon his graduation from the Massachusetts Institute of Technology, Mr. Whittet joined the engineering staff of the State Board of Health, and in the wide field of work covered by that department he found employment congenial to his tastes. Taking a deep interest in its work, he soon became a most valued member of its staff, and was the principal assistant engineer of the department at the time of his death.

He was a civil engineer who believed in the elevation and dignity of his profession, and he acted on this belief with a fine enthusiasm. His principal characteristics, clear thinking and

* Memoir prepared by X. H. Goodnough and J. J. Van Valkenburgh.

sound judgment, were combined with great executive ability, and his early death ended a career begun with great promise.

Mr. Whittet was a member of the American Society of Civil Engineers, the Boston Society of Civil Engineers, the New England Water Works Association, and a prominent member of the Masonic Fraternity.

He was married in September, 1916, to Effie Osgood Byron, of Jamaica Plain, Mass., who, with a daughter, Helen Isabella, born January 16, 1918, survives him.

In appreciation of his service to the state, the State Department of Health adopted the following tribute to his memory:

"Rufus Mason Whittet, C.E., principal assistant engineer of this department, died on December 10, 1918, a victim of the prevailing influenza epidemic.

"Mr. Whittet joined the engineering staff of the State Board of Health upon his graduation from the Massachusetts Institute of Technology in 1902, and has been the principal assistant engineer of the department since 1908

"His energy, thoroughness, clear thinking and sound judgment were of invaluable assistance in the studies of water supply and drainage and the great variety of kindred problems embraced in the work of the department, while his quiet manner, his fairness and his kindness made work with him a pleasure. These qualities, with a high sense of honor and loyalty to his associates, made him respected by all and loved by a wide circle of friends."

Vol. VI SEPTEMBER, 1919 No. 7

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PROCEEDINGS

PAPER IN THIS NUMBER.

"Activities of the Construction Division, United States Army, and the Form of Contract Adopted." By R. C. Marshall, Jr.

Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

MINUTES OF MEETING.

HULL, MASS., June 25, 1919. — A regular meeting of the Boston Society of Civil Engineers was held this afternoon on the lawn of the Pemberton Inn, at the conclusion of a shore dinner which was served in connection with the Joint Field Day and Excursion of the New England Water Works Association and this Society.

Immediately following the dinner, members of the two societies and their guests were favored with a most interesting address by the Hon. William E. Blodgett, formerly mayor of Woburn, Mass.

At the close of his address a unanimous vote of thanks was tendered him by the two organizations, for his courtesy in giving in such an interesting manner his personal experiences in Y. M. C. A. work in France.

The business meeting of the Society was called to order at 3.30 o'clock by the President, Leonard Metcalf.

By vote, the reading of the record of the May meeting was postponed to the regular meeting in September.

The Secretary announced that the Board of Government at its meeting yesterday had elected to membership, in the grade of Member, Mr. Thorndike Saville.

After brief statements by the President in relation to the appointment of a committee on compensation of engineers and in relation to the establishment of a National Board of Public Works, the Society adjourned.

The total attendance of members and guests of the two organizations at the field day and excursion was 127.

S. E. Tinkham, *Secretary.*

APPLICATIONS FOR MEMBERSHIP.

[September 15, 1919.]

The By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

ABBOTT, ROBINSON, Malden, Mass. (Age 28, b. Waterbury, Conn.) Graduate of Tufts College Engrg. School, 1918. From 1908 to 1910, foreman and assistant to G. S. Abbott, contractor, Waterbury, Conn., on water supply of Morris, Conn.; from September, 1910, to March, 1913, with Wm. G. Smith, C. E., Waterbury, on electric railway surveys, construction and final estimate; from March, 1913, to September, 1914, map draftsman on city surveys with A. F. Sargent, Malden; from May to September, 1916, with Mass. Highway Comm. on preliminary surveys; December, 1918, graduated from U. S. N. Officer Material School; from January, 1919, to date, instructor in Tufts College Engrg. School. Refers to E. H. Rockwell, F. B. Sanborn, A. F. Sargent and R. C. Smith.

BROWN, LEO M., Detroit, Mich. (Age 22, b. Boston, Mass.) Graduate of Tufts College, 1918, structural engineering course; past ensign, U. S. N. Was for six months civil engineer for U. S. Government at Watertown Arsenal; is now civil engineer with Thompson-Starrett Co. of New York, on General Motors plant contract in Detroit, Mich. Refers to H. L. Katz, E. H. Rockwell, F. B. Sanborn and R. C. Smith.

CLARKSON, EDWARD HALE, Jr., Newburyport, Mass. (Age 26, b. Auburndale, Mass.) Graduate of Mass. Inst. of Technology, 1916. In 1916 and 1917, assistant instructor at Mass. Inst. of Technology; from September to December, 1917, with American Red Cross Sanitary Service; from April to December, 1918, in U. S. Army; is now sanitary engineer with International Health Board of Rockefeller Foundation on anti-malaria work in conjunction with State Board of Health of Arkansas. Elected a Junior February 21, 1917, and now desires to be transferred to grade of Member. Refers to C. B. Breed, G. L. Hosmer, J. W. Howard, Dwight Porter, C. M. Spofford and G. C. Whipple.

GILES, ERNEST PALMER, San Antonio, Tex. (Age 25, b. Kerrville, Tex.) Student for two years at Univ. of Texas; graduate of Mass. Inst. of Technology, 1918, architectural engineering course, having also completed intensive course in naval architecture. Enlisted as private in U. S. Engr. Enlisted Reserve Corps; was transferred to Navy Dept., and worked for ten months at Boston Navy Yard, first as ship draftsman and later as ship superintendent, Hull Div.; since April, 1919, has been with Alfred Giles Co., architects, San Antonio; when a student, had worked for this firm during vacations. Elected a Junior, November 20, 1918, and now desires to be transferred to grade of Member. Refers to J. B. Babcock, J. J. Harty, Jr., L. J. Johnson, W. H. Lawrence, Dean Peabody, Jr., and C. M. Spofford.

EMPLOYMENT BUREAU.

THE Board of Government maintains an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for

furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society rooms two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

Men Available.

468. Age 26. Received technical education at Rindge Technical School and Harvard College, having graduated from latter with degree of S.B. in 1916; had eleven weeks' instruction in field at Harvard Engrg. Camp. Since graduation has been in various branches of military service, work having been chiefly observation in artillery. Desires position as axman or rodman.

469. Age 32. Has university training in engineering; member, B. S. C. E. Experience covers ten years as transitman, inspector, foreman and superintendent on various constructions. Desires engineering position dealing with concrete sewage, bridge or road construction. Salary desired, $160 per month.

473. Age 24. Has high-school education and has studied civil engineering in I. C. S. course. Has had experience in general municipal work, including sewer construction, paving and topography. Desires position as transitman or inspector of concrete. Salary desired, $1 200 per year.

474. Age 24. Graduate of Tufts College, 1917, degree of B.S. in civil engineering. Experience covers three months on topographical surveying; three months as engineer and inspector on concrete conduit construction; six months on railroad construction; six weeks on reinforced concrete building construction; and about four months on designing and laying out of drainage system and roads for large camp in France; recently discharged from army. Prefers field work as chief of party, transitman or inspector.

475. Age 28. Graduate of Mechanic Arts High School. Employed by Boston engineering firm for nine years, including four years in charge of surveying party; discharged from army June 23, 1919, after eighteen months of foreign service. Desires position as chief of party in any kind of survey work. Salary desired, $1 200 to $1 500 per year.

476. Age 31. Graduate of Mass. Inst. of Technology, civil engineering course, hydraulic option; member, B. S. C. E.; associate member, A. S. C. E. Experience includes three years as assistant engineer on miscellaneous projects, — surveys, studies, design and estimates of railroad grade-crossing projects, water power and supply, building alteration and construction, etc., — and three years in charge of branch office of Boston firm of consulting engineers, on surveys, design and construction of water supply, etc.; recently discharged from army with rank of captain, after eleven months overseas, including two months' active duty at front in command of company. Desires permanent position with firm having hydraulic department; prefers work of executive

nature involving substantially permanent residence. Salary desired, $3 000 per year.

478. Age 27. Has had high-school education and one year in college, specializing in mathematics through calculus; also special course in civil engineering with International Correspondence Schools and business training in real estate, insurance and cost accounting. Since leaving school has been conducting general civil engineering business; has had considerable court experience and done considerable land-court work. Desires to become member of engineering organization with permanent location. Minimum salary desired, $3 000 per year.

479. Age 23. Graduate of Mechanic Arts High School; entered military service of U. S., when in second year of two-year course at Lowell Inst.; was taking course in civil engineering at C. A. officers' school when discharged. Desires position as rodman, with opportunity for advancement.

480. Age 23. Went directly into naval service of U. S. from engineering course at Tufts College, having completed two years at that institution; specialized in reinforced concrete while in service and had considerable experience in road work at U. S. naval ammunition depot; has also had brief experience with firm of architects. Desires position as designer or inspector of reinforced concrete work. Salary desired, $30 per week.

481. Has had technical course in high school and I. C. S. course in surveying and mapping. Has had about six years' experience as rodman, instrumentman and chief of party, including four years on general surveying, road layouts and property research; two months with canal company on construction, and one year with city engineering department on topographical survey and street work; recently discharged from U. S. military service; experience in France covered topographical work, computing and cemetery layouts. Desires position as transitman or chief of party. Salary desired, $20 per week.

482. Age 38. Graduate of Mass. Inst. of Technology, civil engineering course. Has had about fifteen years' experience, chiefly on water-supply engineering, including preliminary work, surveys and construction, — dam, dikes, roads, etc.; served two years with engineers of A. E. F., chemical warfare service, in France and Germany; recently discharged with rank of lieutenant-colonel. Desires position as hydraulic construction engineer. Salary desired, $3 500 per year.

483. Age 23. Graduate of Cornell Univ., degree of C.E. Served twenty-one months as lieutenant with A. E. F.; was engaged in water-supply construction for one year in France. Desires position as sanitary and civil engineer. Salary desired, $200 per month.

484. Age 29. Graduate of Mass. Inst. of Technology, civil engineering course; member, B. S. C. E. Has had seven years' experience, including three years as chief of party and assistant engineer on concrete construction and topographical surveying and two years as second lieutenant in Engr. Corps, U. S. A., on railroad and building construction in France. Desires

position as inspector on construction work or as chief of party or assistant engineer on survey work. Minimum salary desired, $150 per month.

485. Age 33. High-school education. Has had fifteen years' experience as instrumentman and assistant engineer; experience includes municipal and railroad work.

486. Age 26. Four years' scientific course at Lowell High School. Has had more than seven years' experience in surveying, including two years as instrumentman on building construction and two years for government civil service engineers; has been non-commissioned head of camp engineers at army camp for year and a half; for past four months has worked on boundary survey of that camp. Desires position as transitman or chief of party.

487. Age 28. Graduate of Mass. Agricultural College, 1914; student at Trinity College, Dublin, Ireland, during spring term, 1919. Experience includes one year as transitman and draftsman on map work with Massachusetts town; about two years as topographer, construction superintendent and engineer on construction in the Middle West; and one year with the U. S. Army overseas on map drafting. Desires position as transitman on construction work or as landscape superintendent. Salary desired, $25 per week.

Address all inquiries in regard to the following to W. V. Brown, Manager, Engineering Societies Employment Bureau, 29 West Thirty-ninth St., New York, N. Y.

Captain Construction Division, U. S. A., available immediately; wishes to form connection with high-class engineer or contractor, as engineer, superintendent or executive. Technical graduate, age 35; broad construction experience. Highest references. Salary $4 800. A–4383.

Contractor's Engineer, Captain A. E. F.; graduate engineer accustomed to responsibility; successful executive; designs reports, investigations; rapid, accurate quantity estimator on all kinds of construction work. Pacific Coast preferred. A–4444.

LIST OF MEMBERS.

CHANGES OF ADDRESS.

Babbitt, John H. . . . . Engr. Dept., Penna. R. R., Akron, Ohio.
Blanchard, Arthur H. . . . . Univ. of Michigan, Ann Arbor, Mich.
Burleigh, Willard G. 40 Waverly St., Waverly, Mass.
Clarkson, Edward H. . . . . McGehee, Ark.
Davis, Wilbur W. . . . . 1 Beacon St., 6th Floor, Boston, Mass.
Depuy, Clarence S.,
Care Frank Hill Smith, Inc., 120 Broadway, Suite 3062, New York, N. Y.
Flett, Louis E. . . Care Crompton & Knowles Loom Works, Worcester, Mass.

FRAME, JAMES T. 410 Lippincott Ave., Riverton, N. J.
HORNE, RALPH W. 32 Auburn St., Malden, Mass.
HUBBARD, CARL P.,
Care Lockwood, Greene & Co., 38 South Dearborn St., Chicago, Ill.
KENDALL, THEODORE R. 334 South First Ave., Mount Vernon, N. Y.
LEAVITT, ALBERT J. 218 Cliff Ave., Winthrop Highlands, Mass.
LEWIS, GEORGE W. 99 Parkton Rd., Jamaica Plain, Mass.
MOORE, RUFUS R. 59 Granite St., Cambridge, Mass.
RAND, ROBERT Care Corrugated Bar Co., 27 School St., Boston, Mass.
SHAW, ARTHUR L. 395 Chestnut St., Clinton, Mass.
SKILLIN, FRED B. 15 Post Office Bldg., Albany, N. Y.
SNOW, BENJAMIN H. Care Atlantic Corp'n, Engr. Div., Portsmouth, N. H.
SOKOLL, JACOB M. P. O. Box 132, Providence, R. I.
STEARNS, RALPH H. Hotel Puritan, Boston, Mass.
WADE, W. NEWELL 65 Rawson Rd., Norfolk Downs, Mass.
WILSON, ALBERT O. 23 Yale St., Winchester, Mass.
WOOD, FREDERIC J. 57 Westbourne Ter., Coolidge Corner, Mass.

DEATHS.

GOULD, JOHN A. May 18, 1919
PUTNAM, CHARLES E. August 20, 1919

NOTES FROM ENGINEERING COUNCIL.

A COMMITTEE of Engineering Council on Classification and Compensation of Engineers is actively at work as three sections, dealing with engineers in employment of (1) Federal Government, (2) the railroad system, (3) municipal and state governments.

In connection with this matter the following remarks of the chairman of the committee, concerning the proposed "Classification of the Civil Service of Canada," are of interest:

MR. ALFRED D. FLINN, *Secretary*,
ENGINEERING COUNCIL:

Dear Sir, — From time to time within the last few weeks, you have forwarded to me various letters addressed to you concerning the proposed "Classification of the Civil Service of Canada" as recommended by Arthur Young & Co. of Chicago, Toronto and New York. The copy of this classification, which was also received, indicates that its preparation was authorized by the Canadian Parliament, and that the work was done under the direction of the Civil Service Commission.

Your correspondents offer objections to the classification, particularly on the ground that the compensations proposed for higher grades of service are inadequate. In view of the investigation now being made on behalf of Engineering Council as to the classification and compensation of engineers in federal, state, municipal and railroad service, this report is of more than usual interest, and especially so since Council's committee is informed that Arthur Young & Co. are performing a similar service for the Congressional Committee on Reclassification and Compensation of Government Employees, including engineers.

Engineering Council's Committee on Classification and Compensation for the state and municipal services has tentatively proposed that all positions in these services be limited to 13 in number, of which 7 are distinctly professional, while the remaining 6 are in a class directly leading to professional work but not necessarily of a professional character. In the questionnaire recently issued by the committee, the views of the responsible heads of the services affected are being sought, and in the responses which have been received up to the present writing there has been practically unanimous agreement on the classification. The inquiry has not progressed far enough to warrant any expression as to the views concerning compensation, other than to say that there is an unquestionably strong belief that if the engineering service is to be maintained on a proper plane, there must be a very substantial increase in pay.

The Canadian report appears to cover every position in the civil service. It is arranged alphabetically, and in the absence of grouping a complete analysis of the engineering service involves a task of magnitude greater than I have found time for. I have attempted, however, to make such examination as time permitted and am impressed with a belief that the objections raised are well founded. No attempt seems to have been made to standardize titles, consequently there are in the engineering service at least 157 independent titles as compared with the 13 titles proposed by our committee. It is recognized that qualification of a general title to show the nature of the service rendered is quite proper, but in the judgment of the writer there is no reason for treating similar positions as entirely unrelated and as warranting entirely independent specifications.

The report states that the compensations proposed are intended for "normal times," and that pending restoration of such times, the rates recommended should be "supplemented by a bonus"; but no information appears as to the magnitude of the bonus.

From my study of the report it would appear that the groups and ranges of compensation, tabulated as far as practicable under the classification tentatively proposed by Engineering Council's committee, are about as follows:

TABULATION OF TITLES AND SALARIES FOR ENGINEERS IN CANADIAN CIVIL SERVICE REPORT UNDER CLASSIFICATION PROPOSED BY COMMITTEE OF ENGINEERING COUNCIL.

Tentative Classification of Positions in State and Municipal Service proposed by Engineering Council's Committee on State and Municipal Service.	No. of Titles Provided in Proposed Canadian Classification.	Salary Range Proposed for Canadian Service.				Qualifications Proposed for Canadian Service.
		Usual.		Extreme.		
		Min.	Max.	Min.	Max.	
Consulting engineer	1	$6 000	....	....	....	Professional engr., 12 years' exper. (7 in charge).
Chief engineer (major work)	5	6 000	....	$4 800	..	Professional engr., 7 12 years' exper. (3 to 7 in charge).
Chief engineer (minor work)	7	3 900	$4 800	3 600	$6 000	Professional engr., 7 12 years' exper. (3 to 7 in charge).
Chief engineer — deputy	8	3 900	4 800	3 600	5 700	Professional engr., 7 12 years' exper. (3 to 7 in charge).
Engineer	37	3 300	4 020	3 000	4 500	Professional engr., 5–10 years' exper. (2 to 5 in charge).
Senior assistant engineer	40	2 640	3 000	2 400	3 480	Professional engr., 3 years' exper. (2 to 3 in charge).
Assistant engineer	23	2 100	2 580	2 040	3 120	Professional engr., 3 years' experience.
Junior assistant	15	1 680	2 040	1 680	2 160	Professional engr., 2 years' experience.
Senior draftsman	...	...	Included in professional service.			
Draftsman	8	1 260	1 500	....	....	3 years' experience
Junior draftsman	4	900	1 200	...	....	2 years' experience.
Chief instrumentman	....	....	Included in professional service.			
Instrumentman	5	1 260	1 500	....	....	3 years' experience.
Rodman	4	900	1 200	....	....	2 years' experience.

In general, promotion through most of the grades is by increments of about $120, the minimum and maximum rates of each being respectively higher and lower than the rates fixed for the grades below and above, this resulting in a comparatively small salary range for each position and in this respect corresponding with what seems to have been the general practice heretofore. This treatment is one which it would seem desirable to modify, to the end that the relative ability and experience of men performing similar work may be given adequate recognition.

Exceptions are noted in the case of "topographical engineers," where a salary range of from $2 160 to $3 120 is proposed; and in the case of promotion from "junior electrical engineer" at a maximum salary of $1 980 to "electrical engineer" with a minimum salary of $2 640, each of the two latter grades having an extreme salary range of only $360. In the case of "chief draftsman," "structural engineer," and "chief topographical engineer," maximum salaries are proposed of $3 000, $3 240 and $3 840, with no provision for promotion to other engineering grades, although for each position the qualifications required are such as to indicate ability to progress to high positions in the service.

The table also shows that only 6 engineering positions are open to compensation at a rate of more than $6 000 per annum.

It would seem to the writer that this report is open to serious criticism on the ground that it fails to group engineering service along orderly lines, that it provides too narrow limits for promotions within a grade, and that the compensation proposed for all grades is inadequate for the service rendered. The latter criticism seems particularly pertinent in comparison with the rates now being demanded by organized labor. The practicability of properly meeting present-day conditions by the addition of a "special war bonus" to the proposed rates in order to meet the present high cost of living is also to be questioned on the ground that, and as set forth in the circular letter issued by Council's Committee on Classification and Compensation of State and Municipal Engineers, the "revolutionary change in the cost of living" is one which "unless modified by further economic disturbance is likely to be permanent or to continue for a long time to come."

Very truly yours,

(s/d) ARTHUR S. TUTTLE,
Chairman, Committee on Classification and Compensation of Engineers, and of State and Municipal Section.

LIBRARY NOTES.

Recent Additions to the Library.

U. S. Government Reports.

Annual Report of Chief of Weather Bureau for 1917–18.

Anvik-Andreafski Region, Alaska. George Harrington.

Alaskan Mining Industry in 1917. G. C. Martin.

Cadmium in 1918. C. E. Siebenthal.

Contributions to Economic Geology, 1918· Part I. — Metals and Nonmetals except Fuels, F. L. Ransome and others; Part II. — Mineral Fuels, David White and others.

Employment Management, Employee Representation and Industrial Democracy.

Evaporation and Concentration of Waters Associated with Petroleum and Natural Gas. R. Van A. Mills and Roger C. Wells.

Fuel Briquetting in 1918. C. E. Lesher.

Gold and Silver in 1917. H. D. McCaskey and J. P. Dunlop.

Important publications of United States Coast and Geodetic Survey appearing since January 1, 1914.

Iron Ore, Pig Iron and Steel in 1917. Ernest F. Burchard.

Lumber Export and Our Forests. Henry S. Graves.

Municipal Markets in Cities having population of over 30 000. 1918.

(The) Nenana Coal Field, Alaska. G. C. Martin.

Readjustment and Reconstruction Activities in Foreign Countries.

Salt Resources of United States. W. C. Phalen.

Structure and Oil Resources of Simi Valley, Southern California. William S. W. Kew.

Water-Supply Paper 411.

State Reports.

Connecticut. Annual Report of Highway Commissioner for 1918.

Connecticut. Annual Report of Public Utilities Commission for 1918.

Maine. Annual Reports of Public Utilities Commission for 1917 and 1918.

Maine. Biennial Report of State Department of Health for 1916 and 1917.

Massachusetts. Annual Report of Metropolitan Park Commission for 1918.

Massachusetts. Annual Report of Public Service Commission for 1918, Vols. I and II.

New Hampshire. Annual and Statistical Report of Public Service Commission for 1916–17.

City and Town Reports.

Boston, Mass. Reports and Communications of Finance Commission, Vol. XIV, 1919.

Brockton, Mass. Annual Report of Water Commissioners for 1918.

Brookline, Mass. Annual Report of Water Board for 1918.

Burlington, Vt. Annual Report of Water Department for 1918.

Marlborough, Mass. Annual Report of Water and Sewage Commissioners for 1918.

New York, N. Y. Contract of Board of Water Supply for Construction of Gilboa Dam, 1919.

Newton, Mass. Annual Report of Water Commissioner for 1918.

Reading, Mass. Annual Report of Water Commissioners for 1918.

Reading, Pa. Annual Report of Bureau of Water for 1916.

Rochester, N. Y. Report on Problem of Refuse Collection, 1919.

Somerville, Mass. Annual Reports for 1918.

Worcester, Mass. Annual Report of Superintendent of Sewers for 1918.

Miscellaneous.

Aircraft Year Book, 1919. Manufacturers' Aircraft Association, Inc.

Canada, Department of Mines: Annual Report on Mineral Production of Canada during Calendar Year 1917.

Cross Drum Water-Tube Boilers. E. Keeler Co.

Record of War Activities. Turner Construction Co. Gift of C. T. Main.

Remarks on Present System of Road Making. John Loudon McAdam. Gift of C. S. Parsons.

Standard Reinforced Spiral Pipe: Catalogue No. 7.

LIBRARY COMMITTEE.

Vol. VI SEPTEMBER, 1919 No. 7

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications

ACTIVITIES OF THE CONSTRUCTION DIVISION, UNITED STATES ARMY, AND THE FORM OF CONTRACT ADOPTED.

By R. C. Marshall, Jr.,* Brigadier-General, Corps of Engineers, U. S. A.

(Presented March 19, 1919.)

It was suggested to me that I address my remarks this evening to the general subject of the method of contract under which construction operations can be most effectually and equitably carried out. It is with a certain amount of diffidence that I undertake such a discourse, for the subject is so vast and there are so many matters that bear upon methods and forms of contracts for construction work, that in an address of this nature a speaker can at best speak only in very general terms.

I can say truthfully that I am quite familiar with the working of one particular form of contract; that is, the form of contract under which the construction work for the army has been carried on during the period of the war and under the provisions of which construction work was undertaken and is being brought to a close, aggregating in cost in the neighborhood of a billion of dollars.

Before addressing myself strictly to the subject in hand, it may be well to give a sketch or outline of what this War Department work has consisted and the organization by which it has

* Chief of Construction Division, U. S. Army, Washington, D. C.

been carried out. The bureau of the War Department with which I have been associated is the Construction Division of the Army — a bureau set up for the purpose of performing all of the vast amount of construction work which was made necessary by our entry into the war. The work itself ranged from the construction of the camps and cantonments, wooden cities, built within a period of three months, and of a type of construction of the most temporary character, to the port terminals, — projects of steel and concrete, the last word in modern permanent warehouse and dock construction.

From the beginning of its operations, when it was called upon to build the sixteen National Army cantonments and the sixteen National Guard camps, between the latter part of June and the middle of September of 1917, its operations constantly became larger in extent, greater in volume and more diversified in character. Speed was always the primary and governing factor in its work. Every reasonable economy was striven for, but speed was essential. The cost of delay would have been computed not in money alone but in the lives of our soldiers and those of our Allies.

In the beginning, the thirty-two camps and cantonments were a hurry-up call of the first magnitude. In the middle of June, 1917, except in the case of two of the cantonments, not even the sites had been selected although it was proposed to call out the drafted men early in September. In ninety days plans had to be completed, contracts prepared, contractors selected and the field forces organized; and at each of the sites (confining ourselves now to the cantonments), built complete, a camp to cost about $8 000 000 and to house, roughly, forty thousand men and ten thousand animals. Each of these camps had to be complete, with housing, railroad tracks, roads, water and sewer installations, etc. Each was a veritable city, with modern facilities for its inhabitants. It is easy to see that planning, engineering and the construction had to go hand in hand. There was no time for an orderly review of requirements and the careful drawing up of plans and specifications — work had to be begun immediately.

One of the principles of the Construction Division, adopted

in the beginning and adhered to throughout the construction work, was the utilization of existing organizations. It was the opinion of those in charge that not only would these organizations, built up to a high degree of efficiency through the experience of many years, be of tremendous value to the Government, but it was also realized that they should be maintained as important factors in the economic life of the nation. Private building was practically at a standstill, and it was of the utmost importance that the great contracting organizations of the country should not be disrupted and destroyed. For these reasons, aside from the inherent impossibility of performing the War Department construction work with its own organization, it was determined to use the great contracting organizations of the country. In fact, there was no organization of the Government adapted to the purpose, and many more months would have been necessary for the formation of such an organization than were allowed for the completion of the work. The administration of such work under any such method of procedure would have been impossible.

Given the necessity of adopting the existing organizations of the country, the problem remained of how and under what form of contract these organizations were to be employed. The ordinary methods of procedure were pretty generally known, and each was carefully considered by those in charge of the work and by the Emergency Construction Committee of the Council of National Defence. This was one of the subcommittees of that council, designed to aid in the construction work incident to our preparations for the war and composed in the beginning of Mr. W. A. Starrett, of New York, later commissioned a colonel in the Quartermaster Corps; Mr. Frederick Law Olmsted, of Boston; Mr. C. W. Lundorf, of Cleveland; Mr. M. C. Tuttle, of Boston, and Major William Kelly, of the Corps of Engineers. The necessity obviously was for a form of contract combining protection both to the Government and to the contractor, with extreme flexibility, capacity for adjustment to the abnormal conditions of the labor and material markets produced by war conditions, and the possibility of the utmost speed in actual construction work.

The lump-sum contract was, some years ago, almost universally employed, and for it many advantages were claimed. Given stable material and labor markets, a clear conception of the construction desired and abundant time for the preparation of plans and specifications, this form of contract may work well, assuming that in the selection of bidders precautions are taken to choose one capable of properly performing the work.

Under war conditions, such a form of contract is impossible. It is to be borne in mind that the construction for the War Department was dependent on events in Europe and the ever-changing and growing plans of the War Department. Barracks and quarters which were to be designed to accommodate the tactical units of the army were changed and expanded materially after our entrance into the war. New types of buildings for special uses were made necessary by new tactical units organized for special functions in modern warfare. As construction progressed, changes and enlargements were found to be absolutely necessary. In no case when building was started was the completed project clearly delineated or thoroughly fixed in the mind of any one concerned.

In the lump-sum contract, nothing can be done until the drawing and specifications are complete, bids received and the contract awarded; and the contract itself is inflexible in its very nature. With no clear concept of the completed project it is inevitable under this system that important changes, enlargements and additions must be provided for during the progress of the work, involving daily administration, inconvenience and expense, and almost inevitable inequity and dissatisfaction on the part of one or both of the contracting parties.

Moreover, in unstable material and labor markets, the bidder, to protect himself, must place his figures high enough to take care of any fluctuation which may reasonably be considered. This involves a speculative figure unfair to the owner and contractor alike. It is a gamble. The contractor may be reimbursed to a far larger extent than is reasonable, to the detriment of the owner; or, on the other hand, by a sharp rise in the market he may be reimbursed not at all, or driven to the verge of bankruptcy. For the purposes of the Government, therefore, a

lump-sum contract was discarded both by the Construction Division and by the Emergency Construction Committee of the Council of National Defence.

The same objections are inherent to a variation of the lump-sum contract in general use, namely, the lump-sum contract to cover the cost of the main project, with a cost-plus provision for such changes and expansions as may be ordered.

Another form of contract, admirable under certain conditions, but not adapted to the use of the Government during the war, is the unit-price form of contract, whereby a fixed price is agreed upon for construction units, as for example, per thousand bricks in the wall, or per yard of concrete in place. Any estimate, unless it be speculative, must be based on an approximately accurate knowledge of the conditions under which the construction must proceed and the number of units to be completed. Obviously, the volume of the work will have much to do with the estimate. Many of the objections inherent to the lump-sum contract are attached also to this method.

The agency form of contract and its advantages and objections are well known. For undertakings of a peculiar character and of great magnitude wherein conditions of the utmost mutual trust and confidence can be imposed as between principal and agent, it may work admirably. Under ordinary conditions, it is hazardous and has never been a well-established practice in the contracting business.

The contract which finally was adopted for the building of the camps and cantonments is known as the emergency form of contract. In popular language, it is called a cost-plus contract, but strictly speaking it is not exactly that, but a modified form of the cost-plus idea. The natural advantages of this form of contract are well recognized, and this method of contract for the performance of construction work has been for a number of years steadily growing in favor. It is equally flexible for large and small projects, and adjusts itself automatically to variations in plan and to additions to or curtailments from the original estimates. It is equally valuable in stable or unstable market conditions. Under it work can be started as soon as the organization is on the ground, and the planning of the work can go hand

in hand with the actual construction. The disadvantages are that it requires vigilance on the part of the owner, a painstaking check upon all construction costs, and that it encourages extravagance on the part of the contractor and offers temptations for increased cost, accompanied by increased compensation to him.

In the contract adopted, the cost-plus principle governed but there are a number of variations from the usual cost-plus contract. There may be cost plus a fixed percentage; cost plus a flat amount; cost plus a sliding scale of percentages, the percentage decreasing as the cost increases; or cost plus such a sliding scale with an upset price fixed, beyond which the contractor can receive no compensation, no matter what the cost of the job. The last named of these forms was the one adopted by the Construction Division with the advice of the Committee on Emergency Construction. In the original contract for the cantonments, if the cost of the work was under $100 000 the contractor's fee was 10 per cent.; if over $100 000 and under $125 000, 9 per cent.; if over $125 000 and under $250 000, 8 per cent.; if over $250 000 and under $266 66.67, $20 000; and so on down, until it was provided that if the cost of the work was over $3 500 000 the contractor should get a fee of 6 per cent. A special provision was inserted into the contract that the total fee to the contractor should, in no event, exceed the sum of $250 000. These figures were inserted, as I say, in the original contracts for the construction of the National Army cantonments where the cost was estimated to run about $6 000 000 each. Based upon such figures, the contractors' fees would have been about 4 per cent. of the total cost of each project. Actually, due to alterations, enlargements and changes in plans, the cost ran in every case considerably in excess of what had been anticipated. The $250 000 fee, however, remained. It will be observed that, based upon a foundation of percentages, the contractor passed, comparatively early in the building program, the point where all of his fee had accrued. In other words, after this point had been passed, his fee was not increased by a single penny. Consequently, it was to his advantage, both for his reputation and to cut down his own overhead, to finish up the job as speedily and economically as possible.

This principle has been followed with all the emergency construction work done by the Construction Division. The upset fee, of course, has varied in size as the jobs varied in size, but in all jobs of magnitude it has remained constant at $250 000, except in one instance where, by special arrangements, it was made larger on a job costing between twenty-five and thirty million dollars. If, on the other hand, it was anticipated that the project should not cost more than a million dollars, the fixed sum, which could in no case be exceeded, representing the maximum fee which the contractor could get, was made correspondingly smaller. The effort was constantly to check any possible tendency toward extravagance or prolonging the job, in order that the fee might be correspondingly enhanced. It is only fair to the contractors to state that this tendency, the possibility of which is very generally recognized and the existence of which was quite widely asserted by persons not familiar with the War Department construction, was never noticeable, and I believe it never was consciously a policy which any contractor on our jobs tried to follow. None the less, the insertion of the upset fee, judiciously calculated to correspond with the probable cost of the work, was a safeguard the moral effect of which it is hard to overestimate. If any such tendency had existed, it would have effectually operated to check it by rendering such a course of action quite as undesirable from the contractor's standpoint as from that of the Government. It was an answer to charges of ill-advised and gratuitous critics of War Department construction work to which they could never find a satisfactory rejoinder.

The percentages have been changed from time to time, in accordance with the lessons of experience, but the fundamental principle governing the form of contract has been retained all through the construction work for the army during the war. It has been proved to my satisfaction, and to the satisfaction of those who have followed the work, that this form of contract has worked as well, probably, as any scheme of human devising ever does. The tendency to unwarranted extravagance on the part of the contractor is effectually checked, if not prevented, and, coupled with a jealous and effective system of auditing

also provided for in the contract, the rights of both parties are amply protected.

Under this scheme, work on the camps and cantonments was begun between the 20th of June and the 6th of July. Materials were, for the most part, mobilized through the office of the Construction Division. Its representatives, commissioned officers with the title of constructing quartermasters, were on every job. Each constructing quartermaster had his office organization and his engineering assistants to help him in supervising and administering the work on the job. The Government force of auditors began its operations coincident with the starting of the work, and under almost impossible conditions the camps and cantonments were built, — and built on time, — providing for the accommodation of over a million men in a period of about three months. In view of the conditions under which much of this construction work had to be done, I think we are justly entitled to consider it a feat of unusual accomplishment. In the construction of each cantonment, thousands of carloads of freight had to be handled and millions of feet of lumber were nailed up. In many cases, extra railroad facilities were necessary for the handling of the materials, and, due to the location of the sites, it was necessary to import labor from a distance.

The work of the Construction Division itself was sufficiently great. It had on its own account to draw, coördinate and complete plans, twice changed, once on account of the changes of the tables of organization of the army, and once because of the requirements of the office of the Surgeon-General regarding the cubic air space necessary per man. It had to prepare contracts and attend to the selection of contractors, appoint constructing quartermasters, obtain supervising engineers, organize and put into the field auditing organizations. It had to scour the material markets of the country for all of the tremendous quantities of every kind of construction material necessary; engineering problems had to be foreseen; sanitation had to be scrupulously looked after, and sixteen cantonments at an estimated cost of $6 000 000 each and with an estimated capacity of forty thousand people each, and sixteen tent camps at about half the cost but with nearly equal capacity constructed. In the construction

itself, the commercial organizations did the actual work and are entitled to the utmost credit. They did the job and did it well, but the planning, the coördinating and the administration were the problems of the Construction Division.

Without the form of contract which was adopted, it is a certainty that the camps and cantonments could not have been built. It worked so well in these projects that it has been in use, with non-essential modifications, ever since and in all kinds of construction work. It has given universal satisfaction to the division and to the contractors.

At the time of the signing of the armistice, there were four hundred and forty-one separate projects in the United States, completed, or under construction, by this division. It had built hospitals fully equipped with every appliance of modern science, with 121 000 beds; storehouses containing over 700 acres of floor space; 39 000 feet of docks, capable of handling 65 ships at one time; 1 080 miles of railroad tracks; 1 100 miles of highways; housing for 2 250 000 men; with incidental sewer systems, water supply systems, lighting and power plants.

During a period of sixteen months its disbursements were $50 000 000 per month, — more money than was disbursed in the building of the Panama Canal during any year of its construction. The total cost of that project was $375 000 000, covering a period of ten years, and the annual disbursements never extended over $49 000 000.

As the work increased and the program ahead became more diversified, the thought came into the minds of the officials of the Construction Division that some other form of contract might work better than the one adopted, or that some modifications might be advisable. Accordingly, the War Department appointed a committee consisting of engineers, architects, business men and contractors, to go into the subject and make recommendations. The committee was composed of Prof. A. N. Talbott, president American Society of Civil Engineers; John Lawrence Muran, president American Institute of Architects; John R. Alpine, representing the American Federation of Labor; Frederick L. Cranford, president General Contractors' Association of New York; Charles T. Main, president American

Society of Mechanical Engineers; Oscar A. Reum, representative of the president of the Building Construction Employers' Association of Chicago, Ill.; R. S. Rhett, president of the Chamber of Commerce of the United States; and E. W. Rice, president of the American Institute of Electrical Engineers.

A brief extract from the findings of this distinguished assemblage of experts might profitably be inserted here. After reviewing the form of contract under which the operations of the Construction Division were being carried on, the report says:

"No reasonable objection can be pointed out by any one possessing a full understanding of its equitable operations and practice, and finally this scheme appeals to the committee as possessing one qualification which must commend it to all thinking men, — it permits starting actual work weeks, and even months, before the details are completely worked out and delineated, and permits the Government to push the job at any speed it may elect, changing at will its plan and scope, but paying only what the work actually costs, plus a fee which is so reasonable as to be above the reach of fair-minded criticism. The committee therefore advises for emergency construction work . . . the scheme of contract known as 'cost of the work, plus a sliding scale percentage with a maximum upset fee.'"

In all the vast program of building, both that of the simplest nature and that which presented the most difficult technical engineering problems, this form of contract has worked smoothly and well. Whether or not it can be employed to equal advantage during ordinary times and under normal conditions, may be open to question, but I can think of no valid reason why it should not be, given the safeguard of proper checking of costs on the part of the owner or his representative. It relieves the contractors of most of the hazards of that most perilous of undertakings, — figuring on a big job in times of unstable market conditions. It relieves the owner of the payment of an extra fee representing the amount which the contractor must add to his bid as a safeguard against a possible rise in the market. It is at least worthy of careful consideration, and is, no doubt, capable of further refinement and perfection.

Possibly this contract would not be the best for ordinary small building operations such as those conducted by individuals

building their homes or small commercial buildings. It might be difficult for the owner to keep in action a system of auditing and checking which is essential to proper operation under this form of contract. I am far from desiring to create the impression that contractors are naturally dishonest and have to be watched. On the contrary, I am very strongly of the opinion that no body of men in the country are more jealous of their reputation or realize any more vividly the value of an established name for honesty and fair dealing, but when every expenditure made by a contractor is paid for by the owner and these expenditures themselves are made the basis of the contractor's remuneration, it is only just to him, as well as to the owner, to have a careful and accurate audit of all such expenditures. Such an audit is probably impracticable in small building operations.

In such operations, given market conditions of normal stability, the ordinary lump-sum contract should work well. Usually there is no difficulty in knowing just about what is desired, and as time is ordinarily not of the essence of the transaction, there can be close and careful estimates made and bids submitted which will be fair alike to both contracting parties.

It is not with this class of building operations that I and this audience are principally concerned. I have in my mind jobs which cost from half a million dollars upward. Here we are met with different circumstances, and these call for different methods of operation. I believe that it is in such a field that a contract approximating the one which the Construction Division has used during the war will have most value. It is in figuring contracts of this size that the element of chance enters most largely. Contracting on a large scale is a gamble. The contractor wants the job upon which he is figuring, and he desires to do it more cheaply than his competitor, but at the same time he is, if he desires to remain solvent, exceedingly careful not to be caught by changes in the market or by labor disturbances. Some margin of safety he must have, and for this margin of safety the owner pays. There is inevitably a sum larger or smaller as the case may be, but always, in big operations, very considerable, over and above the amount of profit with which the contractor would be satisfied, which the owner has to pay — that is, the

margin of safety. When a contractor figures a lump-sum contract, he takes a chance. All he desires is a fair and just remuneration for his work, his experience and the use of his organization, over and above the expenses to which he is actually put, but he is taking chances not only on wind and weather and the ordinary hazards of building, but he is also gambling on the market, on its stability, and in order to play safe he has to put his figure higher than the sum which he would be willing to accept if he was assured of safety. Even then, sometimes he gets caught. Cast about in your minds and try to remember how many contracting firms have been forced to the wall or have been seriously crippled because of an unfortunate bid upon some large building project, apparently safe, perhaps, when it was made, but which resulted disastrously for the contractor. I contend that the lump-sum contract in large operations works a double hardship: on the owner, because he pays more than he should have to in order to insure a measurable degree of safety to the contractor: and a hardship to the contractor because in spite of sound business judgment, good estimating and a knowledge of conditions, he sometimes inevitably is financially embarrassed or rendered totally insolvent through changes in the market or fortuitous circumstances which he could not foresee.

I believe that the cost-plus contract, with a definite fixed sum, and with suitable auditing and checking, is the way out for both parties, and I commend it to the great organizations of this country concerned in the building of its gigantic construction operations for consideration.

Before I close, I wish to allude to the advantages which always come from the consolidation of construction work of great size under one central authority, composed of an organization of experts in that particular line. The Construction Division was exclusively composed of men drawn from civilian life eminent in their professions, — architects, engineers and builders. It was charged with construction work and construction work alone. It was not burdened with side issues; it had nothing to do with anything but providing the necessary building for the War Department. Soon after it had demonstrated its efficiency, in October, 1917, the Secretary of War placed all of the War Depart-

ment construction work under its jurisdiction. Formerly the various bureaus, — the Signal Corps, the Ordnance, and other divisions of the War Department, — each, in addition to its other specialized duties, had been undertaking to do the building necessary for the accomplishment of its particular task. It is no reflection upon these bureaus to say that the results were not all that they might have been. Building was not their job; it was a side issue. When building was all consolidated where it should be, under a department devoted exclusively to that task, an improvement in results was almost immediately noticeable.

The same principle might, it seems to me, be applied to our Government on an even vaster scale. At present the Government construction work is being carried on by the various executive departments, which each handles independently of the building incident to its particular functions. The Treasury Department, the Navy Department, the War Department, the Department of Agriculture, the Department of Labor, the Department of the Interior and the United States Shipping Board, are each charged with the construction work of its own governmental functions. In other words, these departments are all, to a certain extent, bidding against each other; each is undertaking, as a sort of side issue as it were, a task which is not directly connected with its ultimate object or purpose. It would be well, in my opinion, to consider very seriously the formation of a Department of Public Works under which would be consolidated all of the building for the Government. A moment's reflection will convince any one of what a tremendous executive branch this would constitute — a branch expending probably twenty per cent. of the annual appropriations made by Congress. That such a branch, properly constituted and combining in itself the best talent of the various engineering bureaus and architects from civil life, which have been brought in to assist in the emergency, could effectuate tremendous savings and could accomplish the Government building to far greater advantage than it is at present being conducted, is indisputable.

A closer *rapport* between the Government and the great contracting organizations would be possible; and also — a thing of tremendous importance — closer and more intimate relation-

ship between the Government and the great engineering societies of the country would result. These organizations and associates are indispensable, of course, in time of peace as well as in time of war; but when a national crisis is at hand their aid must be enlisted at once, and in times of crisis, speed is the essence of accomplishment. During the past few months, so filled with events, the response of these organizations and societies has been so generous as to be inspiring, but from the constitution of the governmental agencies with which they had to deal, the greatest measure of good has not always been possible. With the establishment of such a Department of Public Works, it would be the one agency with which they would all be in more or less constant touch and by which they could be recruited at any time of need. My own idea is that such a department should be under a Cabinet officer, and that, properly administered, it would be second in importance to scarcely any of the executive branches of the Government.

I realize that this has been a rather rambling, possibly rather a disjointed talk. I realize, as I said in the beginning, that the subject is too big to treat except along the very broadest lines. If I have succeeded in opening up for your consideration any lines of thought to be pursued by you to the betterment of the economic conditions of this country, I shall feel more than repaid for having inflicted it upon you. It is inevitable that I should have certain more or less firmly fixed ideas as the result of my intimate association for nearly two years with the biggest building program that the world has ever seen, but that these ideas are necessarily, or even probably, perfected or worked out in anything like finished shape, I am too modest to believe. The next few years will offer wonderful opportunities to the engineering brains of America, and the lessons of the construction work undertaken during the war should be a storehouse of inestimable value. I hope it is not necessary for me to assure any society of engineers that the War Department will always be ready to reciprocate the generous help which the engineers of the country gave to it, and to put at their disposal its counsel and its experience.

DISCUSSION.

Frank M. Gunby.* — I thought I would show you pictures of some of the work that we have done. These pictures are not going to be an attempt to show in detail any of the work, but more to give an idea of the diversified character of the problems or branches of work to be met.

I will not go into detail even on those particular projects. Each one of them simply represents one of a type of anywhere from one to fifty different installations, of just enough different character to keep you interested.

In connection with the emergency construction contract, I want to say that I think a tribute is due to the farsightedness of the men who evolved or put together that contract. I say "put together" advisedly, because it is a combination of forms of contracts used by engineers and contractors all over the country, with just enough modifications of the good points selected from various contracts to fit it into governmental procedure.

As we were spending Government money, we had to spend it the Government's way. Sometimes that slowed up the game, as compared to what could be done without such requirements, but I think it is a further tribute to the judgment of those men to say that, due to the business scheme that they laid down and the type of contract they worked out, supplemented by the administration of that contract by the Construction Division, the Construction Division was utterly uninterested as to whether Congress passed that validation act or not. There wasn't a single informal or illegal contract in the whole war construction program as administered by the Construction Division.

Some of us in our previous experience have viewed with tolerance or kindliness, and even with enthusiasm, the use of the lump-sum contract for construction work. I was in that category and always had the feeling that where that form of contract fitted, it was probably the best to use. The experiences of this war have led me to believe that there are certain limitations that

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we should understand in applying that contract, and I will give you what my opinion of them is.

I say this from the standpoint of having helped administer about 550 of the other kind (cost plus a limited fee), so I feel a little bit qualified to say something about both.

I would be a bit inclined to establish as proper conditions for a lump-sum contract, three things :

First, an ability to clearly define what you are contracting for. Meaning by that, definite plans and specifications, both as to the limits of what you are contracting for and the type of what you are contracting for.

Second, that you be able to limit the bidders to men of such reputation that you do not care which one of them gets the job.

Third, that the job shall not be so large as to extend over a period of time too long to assume that a contractor can, with a fair degree of definiteness, predict both his labor and material conditions. My own idea is that the upper limit of the lump-sum contract according to that definition would be somewhere between a quarter and a half million dollars. For all work falling outside of these limits I would advocate a contract similar in principle to the emergency construction contract.

Fig. 1 is a picture of Camp Lewis, at Tacoma, Wash., and is typical of most of the first cantonments. We started in with 16 cantonments and 16 camps. I think there are something over 40 now, — that is, 40 fairly large ones.

This shows the original type of barracks building, which was a large two-story building, housing one company of men, a company at that time being 150 men. One of the little jokers they rung in on us afterwards was in making a company 250 men, — which pretty nearly doubled the floor space required. Roughly speaking, three of these buildings now house two companies. That camp site is really one of the best suited for camp purposes of any we have, because it has a nearly ideal combination of climate, soil, railroad facilities, water, and pretty nearly every other thing that is needed.

The general scheme of handling storage was one of the most difficult to settle at the beginning of the war. As worked out,

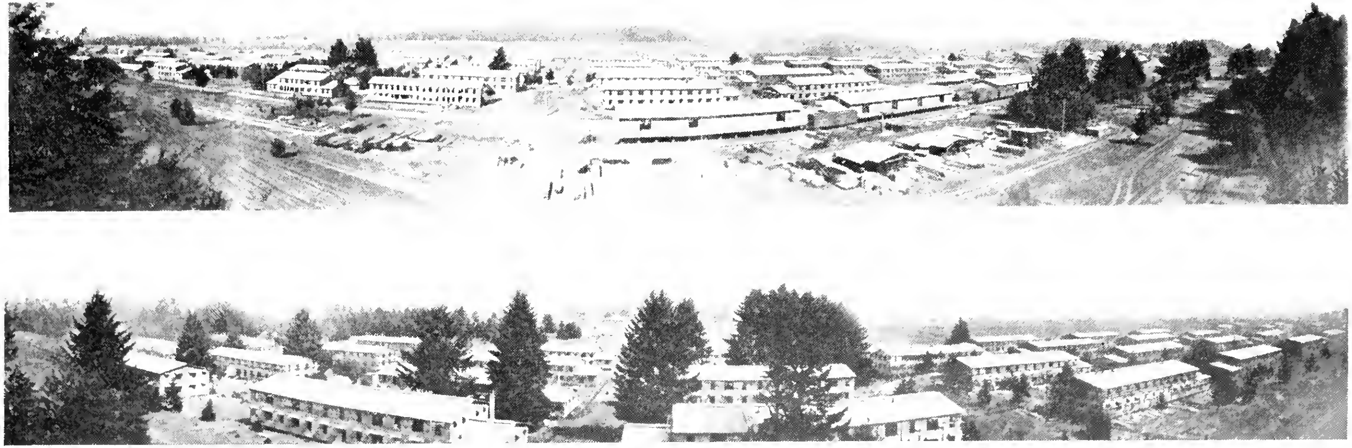


Fig. 1. Camp Lewis, Tacoma, Wash.

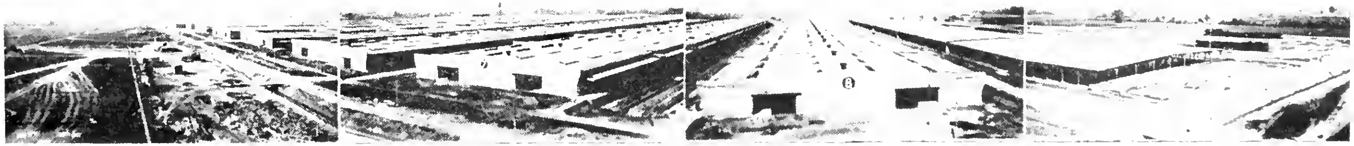
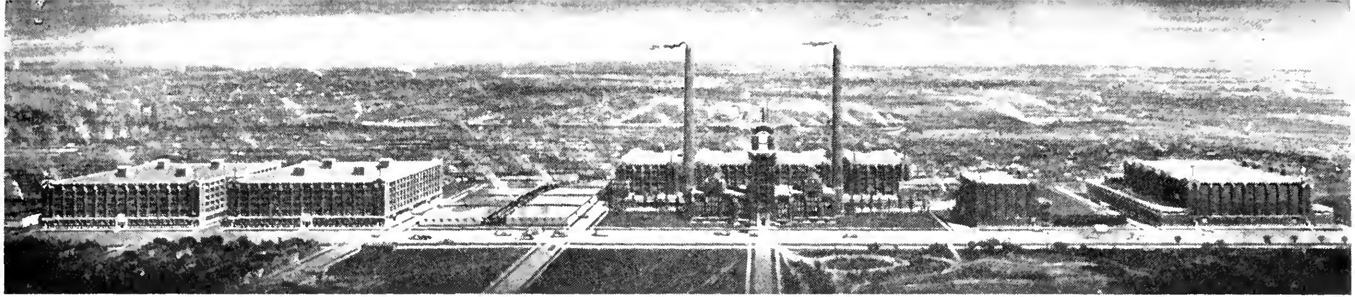


Fig. 2. Storage Plant at Columbus, Ohio.

however, the plan of development called for the building of interior storage depots conveniently located as to railway and manufacturing facilities and for the use of these as storage reservoirs for the terminals at the seacoast, like Brooklyn and Boston. I might say, had this storage as it was later visualized, and now constructed, been ready in the summer of 1917, the scandalous railroad conditions that occurred in the middle of that winter would probably have been eliminated to a very large extent. At that time, however, every bit of storage space in the country was filled. There was also no way of unloading the railroad cars when they arrived on the Atlantic seaboard. On account of this, freight shipments practically had to cease until the next spring, when we could begin to handle them again.

One of these interior storage depots, that of Columbus, Ohio, is shown in Fig. 2. The picture gives a good idea, though somewhat distorted, of the group of eight large warehouses and one covered shed built at that point. Each one of these warehouses is a fireproof building, 160 ft. wide and 1 540 ft. long, and one story high with the exception of one, which provides office space on the second floor. Speaking of these warehouses as typical of the interior depots and similar storage projects, the walls are usually of tile with either wood or concrete floors, depending on the location; generally concrete, however, if we could get it down on the earth. The one open storage building, shown at the extreme right, is principally mill construction. Each building gives about 22 000 sq. ft. of floor space per storage compartment. In general, there are no openings through the fire walls between these compartments, and these walls, extending to the ground, make each compartment an entirely separate fire risk. The question of fire risks in these various storage depots is one that has been made absolutely standard practice, and every project is not only so designed that should a fire occur in one compartment it will not get over into the next one but in addition they are provided with sprinkler systems, a yard pipe and hose system and a complete fire department. From the fire standpoint this practice has proven good, and the reputation made has been even better. The illustration also gives some idea of the length



Permanent Chicago Depot Warehouses. Temporary Warehouses. Central Mfg. Dist. Power Plant, Montgomery-Ward buildings in background. White City Cold Storage Plant. U. S. Government Cold Storage Warehouse.

FIG. 3. PERMANENT QUARTERMASTER DEPOT AT CHICAGO.

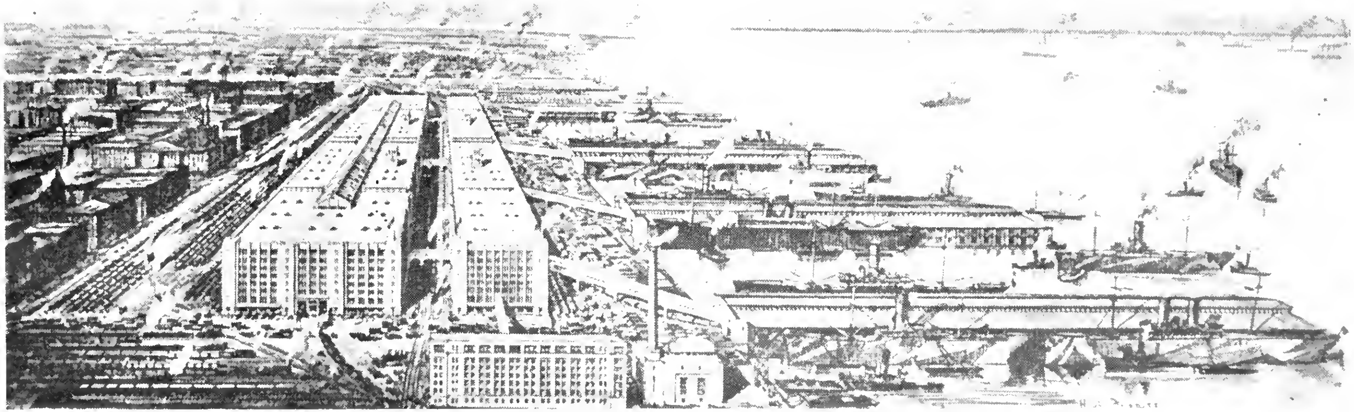


FIG. 4. COMBINED STORAGE AND PORT TERMINAL AT BROOKLYN, N. Y.

of the buildings and the wide platforms extending down each side. I was at Charleston a little while ago, inspecting the Charleston Terminal, which is similar in character to the one at Columbus, and suddenly discovered I was dodging some Ford cars that were running on these platforms, using them for a roadway.

Each storage development had to be located outside of the city, both on account of the space occupied and the necessity for good railroad facilities. In every instance, it was necessary to build barracks to house the troops operating these jobs. The barracks at Columbus are to the right of the picture and do not show in this case, but they are typical cantonment buildings, and some idea of them is given in the illustration of Camp Lewis, Fig. 1. The number of troops to be accommodated was usually from three to five thousand at each depot.

There are two things about cantonments I should like to mention here. The first is that we have yet to have our first case of water-borne disease in any cantonment in America or in any camp; and second, that the fire-prevention people, when they got through grouping the buildings, told us that we would never lose more than one building at a time by fire; and we never have. We have lost a good many buildings, but never more than one at a time, so that the conflagration risk is a thing of the past. As far as I know, that is a record about six times as good as you get in an ordinary city. It is further substantiated by the fact that the losses per capita in the cantonments have been just about one sixth of what they averaged in forty different cities taken at random during the same period, and the fire record established at these interior storage points has been equally good.

Another type of interior storage depot built by the Construction Division is the permanent quartermaster depot at Chicago. (Fig. 3.) This, and the sharp freezer plant nearby, also built by the Construction Division, are on the land of the Central Manufacturing District of Chicago, a realty company using the same railroad facilities as the stockyards. The first of this group was the permanent depot warehouse, a six-story building of reinforced concrete in two units, and similar in construction to the per-

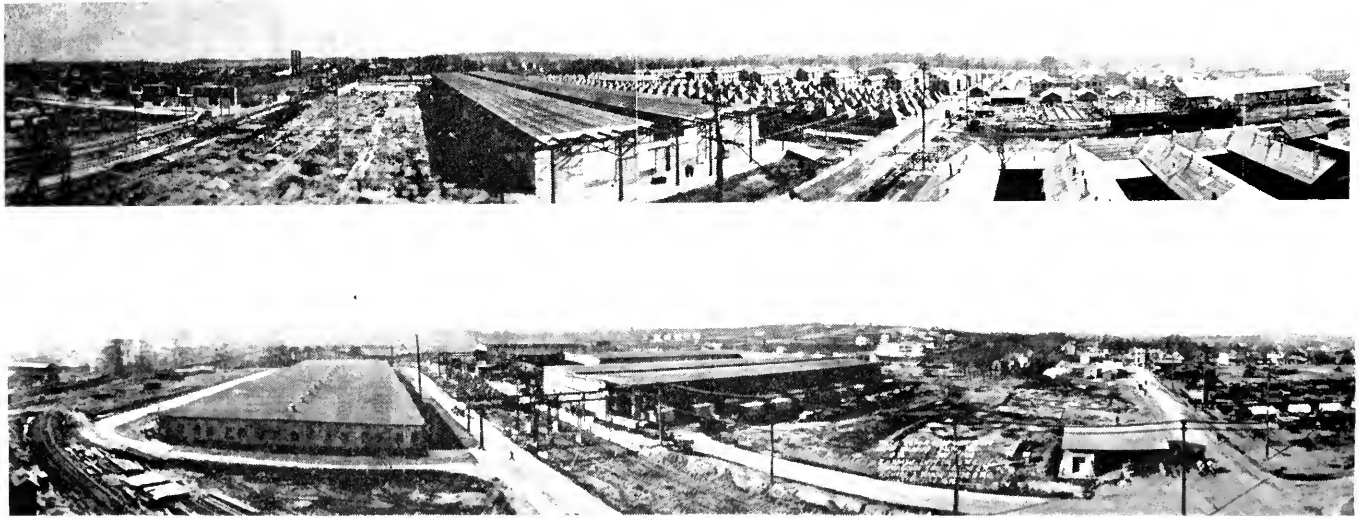


Fig. 5. Mechanical Repair Shop at Camp Holabird, Baltimore, Md.

manent development here in Boston. This building shown at the left of Fig. 3 was completed in July, 1918. The two equal wings of the building are connected by a bridge. There are railroad tracks behind the building and entering the basement, so that all material may be handled from the first story by elevators and ramps. In the center of the picture is the power plant belonging to the Central Manufacturing District with its two stacks. At the extreme right is shown the cold-storage building erected for handling beef in trainload shipments to the seacoast, and thence to France. This is the largest sharp-freezer plant in the world and has a sharp-freezer capacity of over 20 000 quarters of beef and a cold-storage capacity of over 200 000 quarters. Besides this, about 150 tons of ice per day are made. The freezer plant also has direct accommodation for loading and unloading 50 cars of beef at one time. The building has just been finished and will probably be traded back to the stockyard people, or perhaps for some other storage building, though all of these buildings, however, were erected under a contract with the Central Manufacturing District, that they would buy them back at an appraised valuation in case the Government wished to sell them.

Another type of storage project which is more or less familiar to Bostonians is the combined storage and port terminal, seven of which have been built along the Atlantic coast during the past year. The terminal at Brooklyn is the nearest competitor to Boston and started about the same time. A perspective drawing of it is shown in Fig. 4, and those of you who are familiar with the Boston terminal will see that it is somewhat different in plan. It will cost a little more money, probably over thirty million dollars, and is likely to be one of the things you will find standing in the road sometime when you want to get more business for the terminal here. The two storage buildings seen in the left center of the picture are eight stories high, with basements. Railroad tracks come in between as well as along the two outer sides. The two buildings are connected with each other by bridges and there are also similar connections to the three piers and to the administration building and power house in the foreground. The railroad yards, at the left of the two large storage

buildings, connect with the Long Island Railroad. On account of its location a large amount of car storage is necessary and the storage and classification yards can be seen in the illustration. There are sixteen miles of track with a capacity of about 1 200 cars, and the development as a whole was designed for handling at least 10 000 tons of material a day. Four piers, shown in the illustration, are each 150 ft. in width and 1 270 ft. long, giving a total capacity for loading and unloading 16 ships at a time. The general scheme is somewhat different from the Boston development, where the bulkhead type is used. Each pier at Brooklyn has a two-story shed, giving 375 000 sq. ft. of floor area each. They propose to run cars along the sides of these buildings as well as in the case of the eight-story buildings, and then, with a crane on top of the warehouse and little loading balconies, it is possible to handle freight direct from the cars to the various floors without going on the elevators. The buildings are all laid out so that they can be used in the future for manufacturing purposes if necessary.

Another type of work is the mechanical repair-shop unit. Three of these have been built to date, — one at Baltimore, another at Atlanta and the third at San Antonio. The necessity for these is due to the fact that there are something like 35 000 motor cars in this country, of one type or another, belonging to the army. These all have to be cared for, and the three motor repair-shop units are supposed to do this, the idea being to standardize all heavy repair work wherever possible. For instance, if an engine is to be repaired, it has been found much better not to repair the individual engine but if the cylinders have to be re-bored, to re-bore them to the next size and put in a new set of piston rings. In this way the engine is kept standardized, and the records will show at any time just what the status of all the machines is. This standardization of equipment has solved a great many of the army problems. The plant at Baltimore has been added to recently in order to provide facilities for crating trucks for overseas shipment, the general scheme being that trucks go down to the seacoast with their own power, are dissembled and packed at this repair shop and then shipped abroad in the least possible cargo space. The motor truck ready

for shipment consists of two packages, one about 40 in. square and 20 ft. long and the other measuring only 1 by 6 by 12 ft. Like the storage depots, these projects also require a considerable force of men to operate them. Camp Holabird, at Baltimore, for example (Fig. 5), has buildings to accommodate 7 500 men and officers, of whom 3 000 operate the shops while the others are in training for similar work overseas.

The hospital units built by the Construction Division have played an important part, and will probably continue to do so for some time to come. However, as we now have hospital accommodation for about 120 000 beds in this country and have only about half that number of patients, I think we need not get very much excited about the general situation at the present time. This excess of accommodations is due to the fact that we were just getting under way on the general program of having hospitals in various districts in the country when the war stopped. Under this program the patients would be interned somewhere near their homes, so that their relatives and friends could see them without an unnecessary amount of travel. In addition to providing space for the wounded and disabled, we had also to provide for the personnel operating the hospitals, such as doctors, nurses, orderlies, guards and so on.

A typical base hospital is shown in Fig. 6, and is made up of the following units. The ten wards for the patients are the wings extending back from the long building, the head house in the center. Each ward is of two stories, with outside porches and connecting corridors to the other units. This group, like all the hospitals, is built up of the requisite number of wards desired for the total capacity of the plant. If, for example, a hospital for 1 500 patients is to be built, 15 of these wards must be provided for. Beside these, there is the administration and receiving building, just in front of the head house, then across the street from that the quarters for the nurses, officers and the hospital corps barracks with the operating building, Y. M. C. A., laboratory and Red Cross buildings in the right foreground or at one end of the plant. Behind the wards or to the north are the mess, kitchen, shop, storehouses and power house, with the garage and guardhouse at the extreme limit of the project. The head house

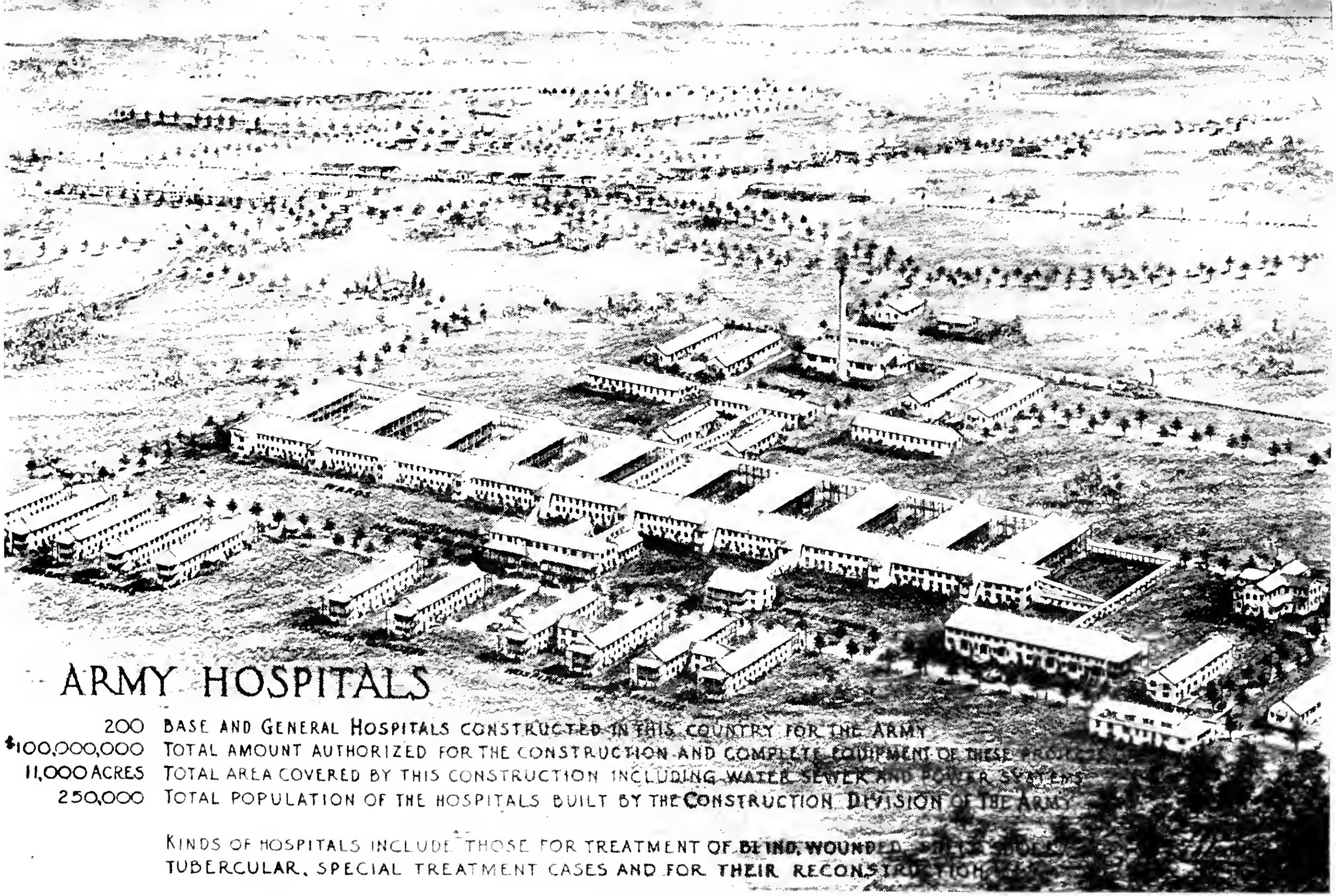


Fig. 6. Typical Base Hospital.

connecting the wards is composed of various rest rooms, diet kitchens, surgeon's office and other offices and special rooms which go to make up a typical up-to-date hospital. The one shown in the illustration is designed to accommodate a thousand patients and it will be noticed that there are ten ward pavilions. The exits from the wards are at other end and all of the units entering into the operation of the hospital, such as the receiving building, post exchange, operating pavilion and the wards themselves, are connected by covered corridors, so that a stretcher may be carried under cover from any one portion of the hospital to another. The buildings are protected by fire walls, and the later hospitals are built of tile and stucco. All of them have wood interiors because we did not have time for anything else. The space between the wings is 60 ft., and ample precautions have been taken in all cases for proper fire protection. I might say that we also have had no fire difficulties at any of the hospitals.

We were criticized at one time because our hospitals were costing about thirteen hundred dollars a bed, where they told us they were building civilian hospitals for eight or nine hundred per bed. We analyzed it and found out that about five hundred dollars out of our thirteen hundred dollars was for facilities which would be furnished from the existing conditions in old cities. That is, in the form of water, sewer, electric light and housing of the doctors and nurses, and that sort of thing.

Then we found the other fellow had made a mistake in his figures. Instead of building at eight hundred, it was fifteen hundred dollars per bed, so the net result on the same basis of comparison was that we were building at eight hundred for temporary construction, while the permanent construction in civilian hospitals cost about fifteen hundred.

I am not going to attempt to explain the Boston terminal to you, gentlemen, because Mr. Fay, Major Gow and Mr. Kearns have explained it to you.

Concerning the developments at Boston, New York, Philadelphia, Norfolk, Charleston and New Orleans, the next problem is what are we going to do with them?

They were built by the War Department from funds appro-

priated for use during the war, and they have a good reason for having been constructed. It seems to me that in considering any use that we might have for those buildings our first consideration ought to be that they were built for war purposes and ought to be kept for such. I do not mean by that kept empty, but kept so that the War Department in case of any future need has them.

Accepting that principle, you almost automatically knock out the idea of manufacturing in them, because if you do, the first thing that happens if the War Department has to take them back is, you would wreck those manufacturing establishments and you would by that process lose one large source of taxes for the Government and lose manufacturing capacity at a critical time also.

It seems to me those terminals must be used as terminals. That is what they were designed for. That is what they will find maximum use for, and as we are now getting some ships on the sea, it seems to me it is necessary we have a place to land them, and these terminals are, I believe, very nearly the only ones in America that have well-balanced storage behind them to take up the slack between railroad transportation and shipping transportation, so we ought to make use of them.

If that is the case, it seems to me these things ought to be operated by the communities themselves. That is, not by the whole Government perhaps, or not by any syndicate representing all the terminals but by a syndicate controlled by each community in which one of these plants is located.

That syndicate would naturally have the viewpoint of wanting to get the most business into its community. If one syndicate operated them all, you would have a tendency to have some port perhaps favored at the expense of others. Certainly if they are operated by a syndicate of your own people, you can only blame yourselves if the other fellow gets more business than you do.

I believe one of the principles of any syndicate like that should be that the standard of success is not how much money the syndicate is making, but how much business it is getting into the community. By the community, I mean the whole section of territory that will be served by these terminals.

I just want to leave these thoughts with you to see if they bear any fruit. I thank you, very much, gentlemen.

H. R. STANFORD.* — The Secretary of the Navy has requested that officers refrain from taking part in public discussions. I will interpret that request as meaning the expression of opinion or views or taking issue with statements or giving personal opinion regarding debatable questions.

I think it proper, however, to give a brief statement of the work that has recently been done by the Navy in this district, in the nature of public works improvements.

There has been one principal operation, — that at Squantum. It involved an expenditure of approximately thirteen and one-half million dollars, and is an improvement designed and created for the assembling of a number of torpedo boat destroyers, the work to be performed by the Bethlehem Shipbuilding Corporation. That construction was performed under a cost-plus percentage basis, the same as the Boston Army Supply Base terminal.

In connection with the Squantum plant there was a shop built at Providence at a cost of about one million dollars, for the building of the boilers; a shop at Buffalo, costing about three million dollars, for the building of turbine engines; approximately two and three-quarter millions of dollars were expended at the Blake & Knowles plant of the Worthington Company at East Cambridge, for power plant, buildings, tools, etc., for the building of pumps, and assistance was rendered in improving the plant of the Sturtevant Company at Hyde Park for building blowers. There were also certain improvements made by the Navy Department at the plant of the Fore River Shipbuilding Corporation and the Bath Iron Works, to facilitate work of shipbuilding at those places. Those operations are all more or less related and were all performed on a cost-plus percentage basis.

There were, beside those operations, various extensive improvements at other places, including additional buildings at Chelsea which provide approximately a thousand additional

* Admiral, Civil Engineer Corps, U. S. Navy, Navy Yard, Boston, Mass.

beds at a cost of about a million dollars; an air station at Chatham, involving an expenditure of one million two hundred thousand dollars; new storehouses, magazines and railroad work extensions at the Ammunition Depot, Hingham, at a cost of about one million eight hundred thousand dollars; camps at Bumkin Island and at Hingham, providing housing for about twenty-two hundred men at each place, with combined expenditure of about one million dollars; and barracks buildings, drill hall and school buildings for the Radio School at Cambridge at a cost of about four hundred seventy thousand dollars. A large reinforced-concrete storehouse, marine ways, machine shop, power-plant equipment and various other improvements have been made at the Boston Navy Yard, involving an expenditure of about two million three hundred thousand dollars. All of the above work has been done on a definite price contract basis except the original contract at Chatham, which was on a cost-plus percentage basis and involved an expenditure of about five hundred forty-seven thousand dollars.

CHARLES R. GOW.* — The war emergency contract is theoretically ideal for all classes of work requiring the services of a contractor. I say "theoretically ideal" only, because it is perfectly obvious that there are many difficulties of a practical nature which must be overcome before it can ever have universal application.

It is safe to assert, however, that under any other form of contract yet devised, the war construction program could not have been as successfully accomplished as was the case. The army had a vast amount of construction work to do which, to meet requirements, necessitated completion within a period of unprecedented briefness. By means of this form of contract it was possible to select the contractor and get him on to the site even before the general plans were completely outlined. The Government retained, throughout the progress of the work, entire control of operations, directing the contractor's methods and procedures whenever necessity required, changing plans, adding or omitting work, suspending operations in whole or in

* Lieutenant-Colonel, Quartermaster Corps, U. S. A., Constructing Quartermaster, Boston Army Supply Base, Boston, Mass.

part, dictating labor or other policies and exercising, at its option, any function ordinarily delegated to the contractor, whenever changing conditions or events rendered such action desirable.

The Government received in return the expert services, ability, experience and special qualifications of the contractor; the use of a trained organization skilled in the particular line of work contemplated and possessing a thorough knowledge of procedure, which resulted in the adoption of the most direct methods for prompt and economical completion. For this special character of service which the contractor brought to the Government's aid, a fee was paid, differing slightly, if at all, in its value from that paid to the engineer or architect for his particular expert service in the conception and design of the project.

In other words, the contractor was employed upon a professional rather than a commercial basis and his relationship was one of adviser and assistant to the owner, rather than an agent to carry out a specific detailed and inflexible agreement.

Under this form of contract the contractor is relieved from practically all financial risks and is reimbursed for the actual cost of operations as the work proceeds. While the maximum fee of $250 000, allowed under the war emergency contract, appears generous in amount, it is so only because of the magnitude of the work involved. In the case of the Boston Army Supply Base which has come under my immediate supervision, the estimated cost was $28 000 000. Upon the expenditure of the first $10 000 000 the contractor had earned the maximum allowable fee of $250 000, and was required to complete the remaining $18 000 000 of work without further profit. It is now known that the final cost will not reach the expected total, but assuming that it did, this fee would be equivalent to less than one per cent. on the cost of the work. As no reimbursement is made for cost of financing certain overhead and legal expenses, this percentage will be further reduced and, after allowing for the Government excess profits tax, the net return to the contractor will be less than one half of one per cent., certainly a very low rate for the valuable services rendered.

It will undoubtedly be argued by many that the average contractor cannot be trusted to give economical and honest

services to the owner, unless held to some strict financial accountability. The reason for this suspicion is largely an outgrowth of experience with the lump-sum type of contract, wherein the owner and contractor gamble on the probable cost of the work. I realize that the owner, at least, will not exactly relish the appellation of gambler, but it cannot be successfully denied that the ordinary lump-sum contract contains several elements of chance, both for the owner and the contractor. The owner usually hopes to escape the burdens of many of the uncertain features in his work, and to this end insists that the contractor shall assume them. He invites competition in the hope that he may thereby receive a low figure for the work, knowing full well that the low bidder is accepting the chances of financial failure which the hidden uncertainties may bring. This is fair enough, in a way, since the contractor accepts the conditions as outlined for him by the owner, but to this extent the cards are stacked against him and he realizes it. He must, therefore, possess the gambling instinct and be convinced that he is a better player at the game of chance than is the owner, otherwise he must lose. He attempts to match his cleverness, in devising methods for overcoming the handicap laid against him, in opposition to the shrewdness of the owner who has drawn an intended iron-clad contract aimed to prevent advantage being taken of any possible loophole.

The two parties are thus put in antagonistic positions toward one another from the first, each seeking to prevent the other from gaining at his expense. Under such circumstances there can be no mutual regard for the interests of the two parties. If the owner has inadvertently omitted to cover a contingency which unexpectedly arises, the contractor cannot be blamed if he demands a strict financial adjustment of the consequent expense because he realizes that had the particular contingency fallen under some blanket provision of the contract, he would have to accept the resultant loss, with only the owner's sympathy to comfort him.

In the last analysis, neither owner nor contractor gains materially from this form of relationship. If an occasional owner succeeds in having his work done at less than actual cost

or at a very low margin of profit to the contractor, there are many more instances in which, if the contractor does not realize an excessive profit, the owner still loses by reason of inferior workmanship, delays in completion or expensive lawsuits. On the other hand, while a contractor frequently obtains an exorbitant rate of profit for his work, his average earnings over a series of years are apt, generally speaking, to be disappointingly small. A brief review of the list of contractors whom any one of us have known will soon demonstrate the fact that very few have retired from their business wealthy.

I realize that many of you engineers, and probably an equal number of my contractor friends, will disagree with my analysis, and defend the lump-sum form of contract as offering superior advantages according to your viewpoints, but you cannot successfully deny that this type of contract has produced about as much, if not more dissension, than any other existing business relationship. Because of the gambling nature of the transaction, there is a mutual feeling of distrust between the contracting parties. Each party generally watches the other closely because he realizes that a premium has been placed upon dishonesty. Only in exceptional cases does the contractor concern himself with the owner's welfare, and then usually for shrewd business reasons. Occasionally, also, an owner may be found who is desirous that the contractor shall not suffer financial loss on account of his contract, but such owners are now generally committed to some form of the fee type of contract.

Before the fee type of contract can become universal, it will be necessary for both parties to alter materially their conception of responsibility. On the one hand, the owner must be brought to understand that the work is being done primarily for his benefit and that therefore he has no moral right to evade full payment for every feature of the undertaking, both known and unknown. It is his object to accomplish something which he is unable to do himself, because it demands training and skill which only an experienced and competent contractor can supply. There can be no valid objections, therefore, to the employment of a carefully selected contractor in whom the owner has confidence and who has demonstrated, in previous cases, his ability to satisfy his clients.

On the other hand, the contractor must come to appreciate the fact that only by establishing a reputation for honest, conscientious effort to promote the interests of his employer, can he expect to succeed in business. With a positive profit assured him in advance, he will be justified in accepting a much lower rate of return than is now required, to offset his frequent losses. He must be educated to the fact that his continued employment in his chosen line depends upon the economic and workmanlike results which he produces and that his interests and those of the owner are identical, so far as these features are concerned.

Whether this result can ever be obtained with the class of contractors produced by the lump-sum method of contracting, may be subject to some question, but, undoubtedly, an evolution is already taking place and there is a gradual growth in tendency, in most large communities in this country, toward a recognition of these principles on the part of certain contractors and owners.

It seems to me altogether probable that a further extension of effort in this direction will result in an approach toward perfection of detail and that the time may yet arrive when the contractors will generally be employed only because of their recognized fitness for the work to be done and for their reputation for honesty, economy and dependability in a business way, rather than because they are willing to take a gambler's chance of winning or losing on the basis of a lump-sum bid with the cards stacked against them.

William F. Kearns.* — I had not anticipated that I would be called upon to speak, but I am glad of the opportunity which is now afforded me to endorse all that Major Gow has said regarding the cost-plus contract. In the past I have been an ardent advocate of the lump-sum form of contract, but I have been converted during the last few years and I am now thoroughly convinced that the cost-plus is really the better proposition. It is certainly the more honest form, eliminating as it does that element of chance which is always present in the lump-sum contract. I do not think a more equitable form of contract ever has been devised. I hope it will soon be adopted generally, and it is going

* Of W. F. Kearns Co., General Contractors for Boston Army Supply Base, Boston, Mass.

to be my aim to see that it is put into use wherever possible, both in private and public work.

CHARLES T. MAIN.* — I can add very little to what General Marshall has said in connection with the cost-plus contract. When the form of contract was criticized by some Congressmen, I had the honor to be appointed on the commission to look into the form of contract and to report as to its advisability.

We sat for three days, and very carefully discussed every phase, every feature of all forms of contracts, and of any other method of conducting work of this sort, and the conclusions which the commission reached have been given to you by General Marshall. We were unanimous in the opinion that under the circumstances existing no other form of contract could be used.

I have been surprised and shocked at the remarks of my friend here, Major Gow, to find that during the most of my years of experience in engineering business I have been living such a checkered life. Up to within ten or fifteen years, I with all other engineers used the lump form of contract, and we thought we used it with very good success.

In those days the prices of materials and labor were not so unstabilized as they are at present, and wherever the conditions were definitely defined and we could make definite plans and write definite specifications, we thought, and I think contractors thought, that everybody was getting a square deal.

I know that one contractor thought that he was not a gambler when he was bidding on our plans, because he told me there was no fun in bidding on them as there was no guessing to be done, they were so definite; and many of my clients up to this day are very much opposed to any other form of contract and are willing to expend sometimes several thousand dollars more than they might otherwise on another form of contract for the purpose of getting rid of the complicated accounting system which looks like a bugbear to them, and they are willing to pay a contractor perhaps $10 000 more on the lump sum to do a job and have it done in a clean-cut way and have nothing to bother about in the accounting.

* Consulting Engineer, 201 Devonshire Street, Boston, Mass.

I doubt perhaps if we ever, those of us who are the older members of the Society, will see the conditions so stabilized that we will be able to get lump-sum contracts on very much of our work, and I believe myself that the best way, the fairest way, to conduct the work is to do it on a cost-plus basis, but I have got to educate some of my clients to make them see that. If conditions ever get stabilized again, I am sure we are going back in some of our work to lump-sum contracts.

I think also that perhaps if we get the right contractor, and there are a lot of them, and I hold them in the very highest respect, that it is better for the engineer to have that form of contract. It seems to me to make less trouble in many ways. There are some disadvantages to the other form.

I think that the workmen on the job soon know that the contract is not for a lump sum, that it is on a cost-plus or cost-percentage basis, and they begin to slacken up in their efforts, and there are other reasons why work does not proceed as economically as it would under the lump-sum form.

Vol. VI OCTOBER, 1919 No. 8

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PROCEEDINGS

PAPERS IN THIS NUMBER.

"The Equipment of the Commonwealth Dry Dock, Boston, Mass." Frank W. Hodgdon.

Memoirs of deceased members.

MINUTES OF MEETINGS.

BOSTON, September 17, 1919. — A regular meeting of the Boston Society of Civil Engineers was held this evening at Chipman Hall, Tremont Temple, and was called to order at 7.50 o'clock by the Senior Vice-President, Leonard C. Wason.

There were present fifty-five members and visitors.

The record of the May meeting was approved as printed in the June JOURNAL and that of the June meeting was read by the Secretary and approved by vote of the meeting.

The Secretary reported for the Board of Government that it had elected to membership in the grades named the following candidates:

Members — Walter Scott Fox, Edward Allen Varney.

Associate — Ransom J. Rowe.

The Secretary presented reports for the committees appointed to prepare memoirs of deceased members as follows: Memoir of John Allen Gould, prepared by Messrs. Desmond FitzGerald and William A. Wood; memoir of Gilbert Hodges, prepared by Messrs. Ephraim Harrington and Arthur W. Hodges.

By vote the memoirs were accepted and ordered printed in the JOURNAL of the Society.

The subject for discussion at the meeting was "The New Boston Dry Dock."

Mr. James W. Rollins with the aid of lantern slides described very fully the construction work of the dock, and Mr. Frank W. Hodgdon followed with a description, also illustrated with lantern slides, of the pumping, caisson and capstan machinery as installed at the dock.

After a short discussion, the meeting adjourned.

S. E. TINKHAM, *Secretary.*

BOSTON, June 4, 1919. — The Sanitary Section of the Boston Society of Civil Engineers held a special meeting this evening in the Society Library, Tremont Temple. The meeting was called to order by the chairman, Edgar S. Dorr, at 7.45 P.M.

The Clerk read the names of the new members enrolled in the Sanitary Section by the Executive Committee.

The chairman introduced Mr. H. W. Rowley, M.E., of Boston, who spoke on "The Final Disposal of Boston City Wastes." Mr. Rowley explained the method of collection and separation of the garbage and other wastes of the city of Boston; the garbage reduction plant was described in detail. The talk was finely illustrated by lantern slides.

On motion of Mr. Fales, a rising vote of thanks was given to the speaker for his interesting address.

The meeting adjourned at 9.50 P.M. Attendance, sixteen.

JOHN P. WENTWORTH, *Clerk.*

BOSTON, June 5, 1919. — The Sanitary Section of the Boston Society of Civil Engineers held an excursion this afternoon to the garbage reduction plant at Spectacle Island. The party left the Public Landing, City Point, South Boston, at 2.30 P.M., in a tug furnished by the Boston Sanitary and Development Company. At the island the party was met by the superintendent who showed the members about the plant and explained the operation in detail.

At 5 P.M. the party returned to Boston.

On motion of Mr. Coburn, it was voted to extend a vote of thanks to the Boston Sanitary and Development Company for their courtesy in arranging this excursion.

Members present, sixteen.

JOHN P. WENTWORTH, *Clerk.*

APPLICATIONS FOR MEMBERSHIP.

[October 15, 1919.]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

CHISHOLM, HENRY, East Boston, Mass. (Age 25, b. East Boston, Mass.) Graduate of Mechanic Arts High School, 1912; studied railroad engineering at Y. M. C. A. and elements of structures in extension course of Wisconsin University; student at Lowell Inst. last year. During school vacation, 1911, draftsman with W. M. Bacon, architect; from June, 1912, to November, 1915, construction draftsman with Forbes Lithograph Mfg. Co., Chelsea; from November, 1915, to March, 1918, assistant to construction superintendent with United Shoe Machinery Co., Beverly; from March, 1918, to date, draftsman and engineer with Swift & Co. Refers to B. A. Bowman, H. L. Carter, R. H. A. Carter, Channing Howard, Robert Rand and S. E. Stott.

JONES, FREDERICK ELMER, Somerville, Mass. (Age 50, b. Cambridge, Mass.) Grammar School education, supplemented with courses at Normal Art School, Prospect Union, Y. M. C. A., etc. From April, 1887, to date, with engineering department, city of Somerville, with exception of about three months as rodman and draftsman with B. & A. R. R.; is now assistant engineer. Refers to E. W. Bailey, F. R. Charnock, C. H. Gannett, C. A. Pearson, T. P. Perkins and J. P. Snow.

LIST OF MEMBERS.

ADDITIONS.

ROWE, RANSOM J. . . . . 45 Milk St., Boston, Mass.
VARNEY, EDWARD A. . . . . Wentworth Inst., Boston, Mass.

CHANGES OF ADDRESS.

BOWERS, GEORGE W. . . . . Bank of Piræus, Athens, Greece
BRACKETT, LEROY G. . . . . 20 Monument St., West Medford, Mass.
DONOVAN, FREDERICK P. . . . . 57 Crawford St., Roxbury, Mass.
DRUMMOND, WILLIAM W. . . . . Fort H. G. Wright, N. Y.
HORTON, FREEMAN H. . . . . Missouri Highway Dept., Jefferson City, Mo.
HYDE, EDWARD R. . . . . Manila, P. I.
KING, ARTHUR C. . . . . R. F. D. No. 1, Box 111, South Braintree, Mass.
NASH, PHILIP C. . . . . 5 Mansfield St., Allston, Mass.
SMITH, CHESTER W. . . . . 249 High St., Newburyport, Mass.
WARING, CHARLES T. . . . . 420 Ninth St., Philipsburg, Pa.

EMPLOYMENT BUREAU.

THE Board of Government maintains an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society rooms two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

MEN AVAILABLE.

488. Age 28. Received technical education at Sheffield Scientific School, Yale University. Experience covers general construction, surveying and lumbering. Desires outside position. Salary desired, $1 500 per year.

Address all inquiries in regard to the following to W. V. Brown, Manager, Engineering Societies Employment Bureau, 29 West Thirty-ninth St., New York, N. Y.

Engineer of seventeen years' experience in hydraulic work desires executive position. Experience includes four years' studies and investigations, five years design, five years construction, three years maintenance and operation. Last position with U. S. Army, operating water supply and sewage disposal systems of army cantonment. A-4870.

NOTES FROM ENGINEERING COUNCIL.

According to the best information obtainable by the License Committee of Engineering Council, laws providing for licensing of engineers are on the statute books of the following eleven states:

Wyoming, 1907.	Idaho, 1915.
Louisiana, 1908 (amended, 1914).	Florida, 1917.
California, 1909.	Oregon, 1919.
South Dakota, 1913.	Colorado, 1919.
Illinois, 1915.	Michigan, 1919.
Iowa, 1919.	

The License Committee is working on a draft of a typical bill which, it is intended, can be used if necessity should arise in states proposing new legislation on this subject, or in those proposing revisions, so that laws enacted for licensing engineers may be uniform, or nearly so, throughout the country.

Engineering Council, however, has as yet taken no stand on the desirability of licensing or registering of engineers. It desires to learn the opinions of engineers in various branches of the profession in all parts of our country; also to secure soon all information that would be helpful to the committee.

LIBRARY NOTES.

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Pulpwood Consumption and Wood Pulp Production in 1918.

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National Board of Fire Underwriters: Motion Picture Film: Résumé of Results of Tests on Protective Requirements for Safe Storage.

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LIBRARY COMMITTEE.

Vol. VI OCTOBER, 1919 No. 8

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications

THE EQUIPMENT OF THE COMMONWEALTH DRY DOCK AT BOSTON, MASS.

By Frank W. Hodgdon,* Member Boston Society of Civil Engineers.

(Presented September 17, 1919.)

The Dry Dock. — The Commonwealth of Massachusetts, acting through the Commission on Waterways and Public Lands, has undertaken and nearly completed the construction of the largest dry dock in the world. The dock is admirably located at South Boston, and connected by a short approach channel to the main ship channel of the harbor. Its floor and dock walls rest directly upon solid ledge rock, — the typical slate of the Boston basin. The walls are constructed of mass concrete with a lining of granite on the inside and designed as a typical gravity section, providing for several altars 2 ft. in width.

The over-all length of the dock is 1 200 ft., measured from the coping at the inner end to the coping of the wing walls at the entrance; and the width is 149 ft., measured between copings of the side walls. The entrance section has a width of 133 ft. at the coping, with sides sloped on one to eight batter, affording a width of 120 ft. at the elevation of the top of the sill. The top of the dock wall is level 16 ft. above mean low water, and the

* Engineer, Commission on Waterways and Public Lands, State House, Boston, Mass. Mr. Everett N. Hutchins, Assistant Engineer to the Commission, assisted in the preparation of the paper.

sill at entrance is 35 ft. below mean low water. Mean high water increases this depth over sill to 45 ft.

The maximum length of ship which can be placed in this dock is 1 140 ft. In order to dock smaller ships economically, an intermediate sill was constructed as part of the dock structure, the dimensions of which are similar to the entrance section, and this sill is placed so that the length of the inner section of the dock is 668 ft. measured from the inner end to the intermediate sill, and the remainder or outer section is 520 ft. long, providing for two ships of 635 ft. and 490 ft. in length, respectively.

The conduits for filling and draining the dock consist of the following: One conduit 14 ft. wide and 15 ft. high, of arch section, extends from the outer end of the dock to a point in front of the pump house, a distance of approximately 430 ft., and is designated as the discharge conduit, receiving water from the main pumps. In the reverse operation this acts as a filling conduit by emptying through two sluice gates, each 6 ft. by 8 ft., placed in the side of the conduit directly opposite the discharge from the main pumps. These gates discharge into filling chambers, which act also as diverting chambers, and connect with four conduits leading out to the under side of the dock floor. One filling sluice gate fills into the two conduits which lead to the outer section of the dock and the other to the two conduits extending to the inner section beyond the intermediate sill.

These same four conduits become drainage conduits during the process of pumping out the dock, and they extend to a common suction chamber. Each conduit, however, is provided with a separate sluice gate 6 ft. by 8 ft., making it possible to shut off any one from the suction chamber. These six gates (four drainage and two filling) are operated by means of oil-operated hydraulic cylinders $19\frac{1}{2}$ ins. in diameter, located in a special chamber outside of but connected by a passageway to the pump well. The pressure used to operate these gates is 300 lbs. per square inch.

THE PUMPING PLANT. — The pumping plant consists of three main pumping units, two small drainage pumping units, one sump pump and two oil-pressure pumps, all of which with

the exception of the oil-pressure pumps are of the vertical shaft type, each consisting of a volute centrifugal pump, direct connected to an electric motor. The main dry dock pumps (Fig. 1) have a 54-in. suction and discharge, and each is operated by a 1 250 horse-power constant-speed electric motor. The suction of each pump is connected directly, without a gate valve, to a

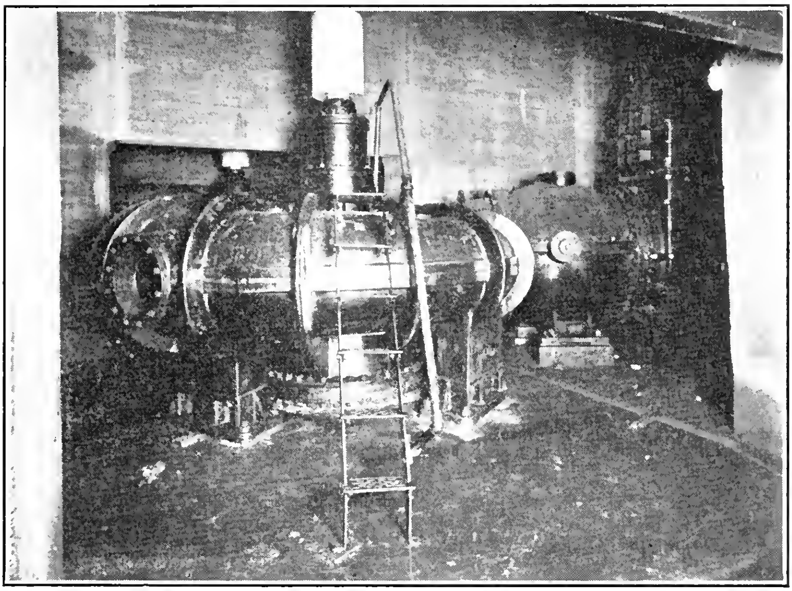

FIG. 1. MAIN DRY DOCK PUMP.

separate concrete conduit extending to the common suction chamber. The discharge from the pump connects to a check valve of special design of the butterfly type, beyond which is located a 54-in. gate valve, operated by an hydraulic cylinder, and an increase from 54 ins. to 60 ins. diameter, the size of the large cast-iron pipe which delivers the water to the main discharge tunnel. The operation of the check valve is cushioned by means of an oil dash-pot, connected by piston rod and crank to the shaft of the flapper. The pump impeller is of cast iron and is 71 ins. in diameter. The pump is placed in the pump well so that its center line is at an elevation of 9.5 ft. above the

floor of the dry dock. The motor of the pump is located on the main floor of the pump house (Fig. 2), which is 55.5 ft. above the dock floor, or 1 ft. higher than the coping of the dock and 46 ft. above the pump. The motor is the constant-speed induction type, having a speed of 240 r.p.m. The total weight and thrust of the pump impeller, shaft and rotor of motor, are

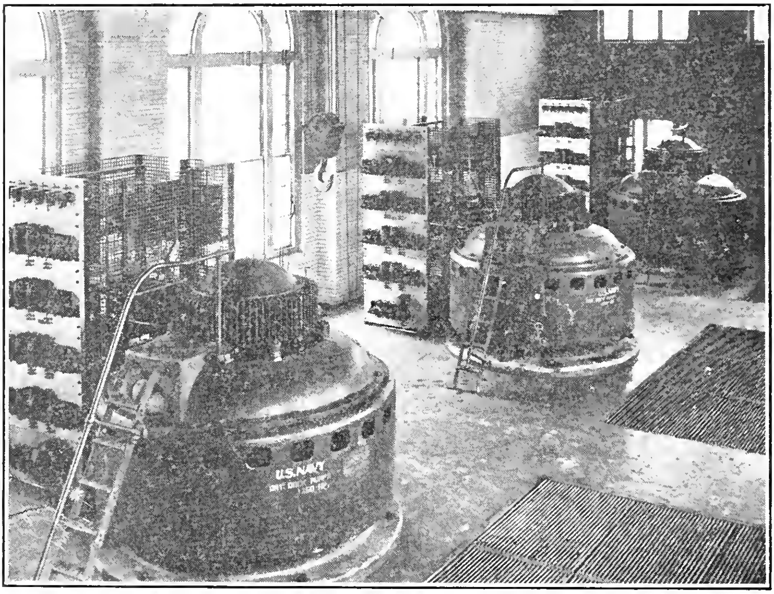

Fig. 2. Motors for Driving Main Dry Dock Pumps.

sustained by a spring-supported thrust bearing, the rubbing surfaces of which are constantly in a bath of oil.

The guaranteed capacity of each main pump is 100 000 gals. per minute, and the combined average over-all efficiency of the pump and motor is 56.5 per cent. Official tests indicate a slight excess in both of these figures. The three pumps operating together are capable of completely unwatering the dock in two and a half to three hours.

The two small drainage pump units are of the same type as the main pumps and have 15-in. suction and discharge openings. Their main function is to drain the dock floor and conduits under-

neath, which lead into the common suction chamber. From the bottom of this chamber a 20-in. pipe, controlled by a hand-operated gate valve, extends to 15-in. branch pipes with a hand-operated gate valve on each pump suction. The discharge of each pump is connected through a 15-in. gate valve, operated by hydraulic oil pressure cylinders, to the common 20-in. discharge

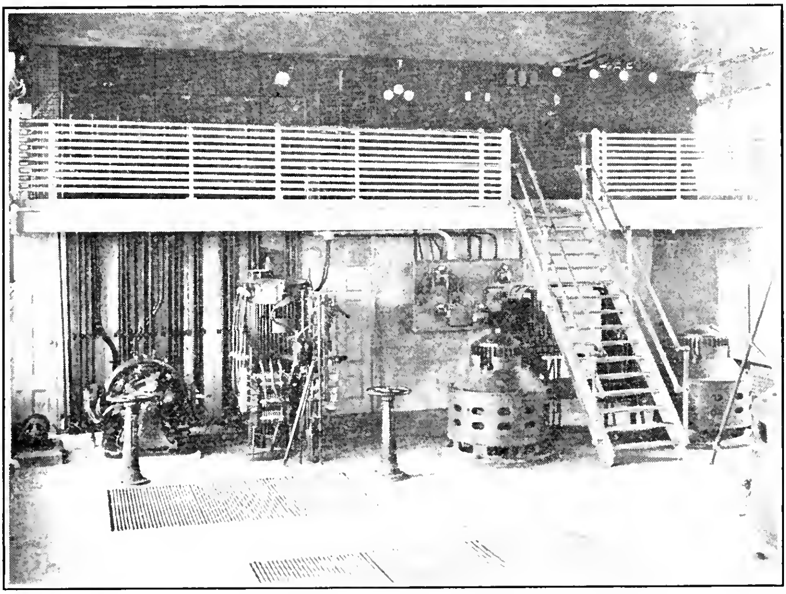

FIG. 3. MOTORS FOR DRIVING DRAINAGE PUMPS.

pipe, which contains a four-port check valve, and extends outside of the pump well in the masonry of the dock wall to the outer end of the dock and is wholly independent of the main discharge conduit. The 20-in. suction pipe mentioned above connects by means of a Y-branch and hand-operated gate valve to the bottom of the main discharge conduit, so that this may also be pumped out, after placing stop planks in grooves provided at the outboard end. There is also provided a 20-in. tee branch provided with a gate valve and suction pipe for pumping out the pump well itself, in case of emergency. These pumps are located 4.5 ft. below the dock floor, and their motors (Fig. 3)

are on the main floor of the pump house, 60 ft. above. Each of these motors is rated at 150 h.p., having a speed of 600 r.p.m., operating on 3-phase, 60-cycle, 440-volt current. The type of thrust bearing is the same as for the main pump motors.

The guaranteed capacity of each drainage pump unit is 6 400 gals. per minute, and the combined average over-all efficiency of the pump and motor is 52.0 per cent. Official tests indicate an excess of both of these figures.

In addition to this equipment for operating the dock proper, a small 3-in. centrifugal pump is installed in the sump at the bottom of the pump well, 72 ft. below the pump-house floor, for removing the seepage into the pump well. The discharge from this pump connects into the discharge pipe of the 15-in. pumps. This pump is controlled by an automatic switch, which is operated by a float in the sump chamber.

The electrical equipment is controlled by a switchboard located upon a balcony above the main pump-house floor. The operation of hydraulic cylinders on sluice gates and valves of main and drainage pumps is controlled at another board adjacent to the switchboard, thus affording centralized control for all apparatus. The power for operating the pumping plant is derived from 3-phase, 60-cycle, 13 800-volt service supplied by the Edison Electric Illuminating Company. From this 13 800-volt bus are taken two circuits through separate high-tension oil switches, one of which passes to a bank of three single-phase transformers, each of 1 250 k.v.a. capacity, stepping down the high-tension supply of 13 800 volts to 2 200 volts required by the main pump motors. The other circuit passes to another bank of three single-phase transformers each of 150 k.v.a. capacity, stepping down the 13 800-volt supply to 440 volts required by the other motors of the pumping equipment, the caisson pumps and other uses at the dock.

Miscellaneous equipment consists of a storage-battery charging set for operating high-tension switches and relays; two triple-action plunger pumps with an accumulator to maintain an oil-pressure supply system for operating sluice gates and gate valves; a 220 k.w. rotary converter for supplying the five electric capstans with direct current at 250 volts. There is

also a 20-ton hand-operated traveling bridge crane in the pump house, for handling pumps and motors.

In order that the operator may be constantly informed during any operation of the dock as to the tide elevation and water level within the dock, there have been placed at a convenient location on the operating balcony three recording water-

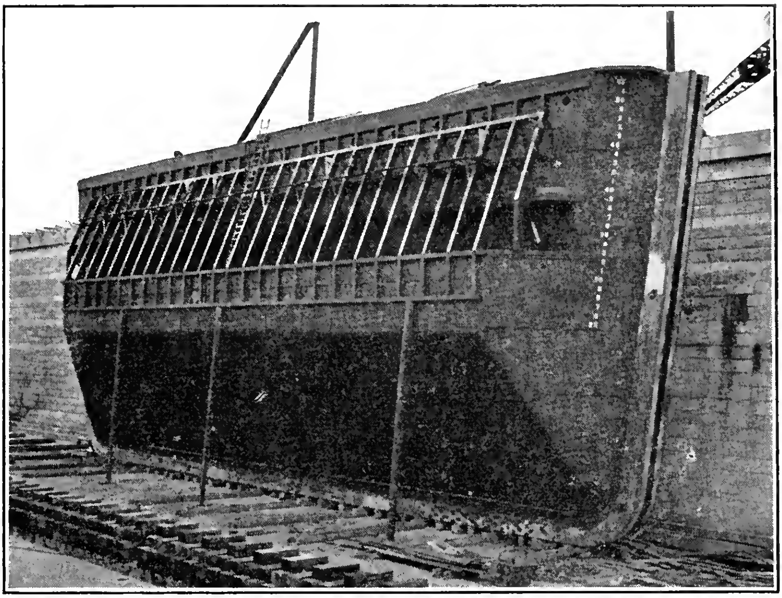

Fig. 4. Caisson for Closing Entrance to Dock.

level gages, one of which indicates tide level and the other two dock levels, one for inner and the other for outer dock sections. These gages are manufactured by the Sanborn Company and give very satisfactory indication of the water levels.

The Caisson. — The caisson (Fig. 4) for closing the entrance to the dock is of the hydrometer type, and when in position rests against a granite sill extending along the bottom and sides of the entrance section of the dock. The caisson is practically a ship, 138 ft. 6 ins. long, 53 ft. high, a maximum width of 27 ft. and minimum draft of 28.5 ft. In order to dock a vessel, the dock is filled with water to the same level as the

tide outside. Sufficient water ballast within the caisson is then pumped out by means of its own pumps until flotation at suitable draft is obtained and the caisson moved from the dock entrance by lines from the caisson to electric capstans located beyond the dock wall. After the ship has been placed in the dock, the caisson is then drawn into position, filled with water ballast until it rests on the bottom of the sill, and the dock then pumped out.

Structurally, the caisson consists of a series of steel girders with an outside plating or shell of steel, so that it floats as a ship, the lines of which are straight, however, instead of curved. The bottom of the caisson is filled with concrete ballast, above which is a space for the variable quantity of water ballast required for operating the caisson under varying conditions of draft. Water ballast is admitted to the caisson through two 10-in. pipes on each side of the caisson, these pipes extending from the outside plating and discharging free to the interior of the caisson, but each controlled by two gate valves, one of which is a quick-closing gate. The water ballast is removed by means of two 20-in. volute centrifugal pumps of vertical shaft type. These pumps discharge at opposite sides of the caisson. Each has a five-port foot valve on suction, a motor gate valve at the pump discharge, and a flap valve at the end of the discharge pipe, just outside the caisson plating.

On the main or operating deck (Fig. 5) are located the 60 h.p. motors for each pump, the motor-operated stands and hand-operated stands for all gate valves, the switchboard, delicate inclinometers for indicating the trim of the caisson, and a float gage which indicates the depth of water ballast within the hold. This main deck is made watertight but provided with two small inspection hatchways and one large machinery hatchway which provides an opening from the upper deck to the bottom of the caisson.

The motors on the caisson are operated on 440-volt current from the pump house, a flexible armored cable 200 ft. long being provided to connect between the caisson and a specially designed outlet box located on the dock wall. Similar provision is also made for supplying electric lights to the caisson.

CAPSTANS. — For pulling the vessels into and out of the dock, five large electrically operated capstans are installed, each capable of exerting a pull of 30 000 lbs. at 30 ft. per minute and 10 000 lbs. at 90 ft. per minute. One of these capstans is located at the inner end of the dock for hauling vessels in, and the other four are located on the two sides of the dock, one pair near the

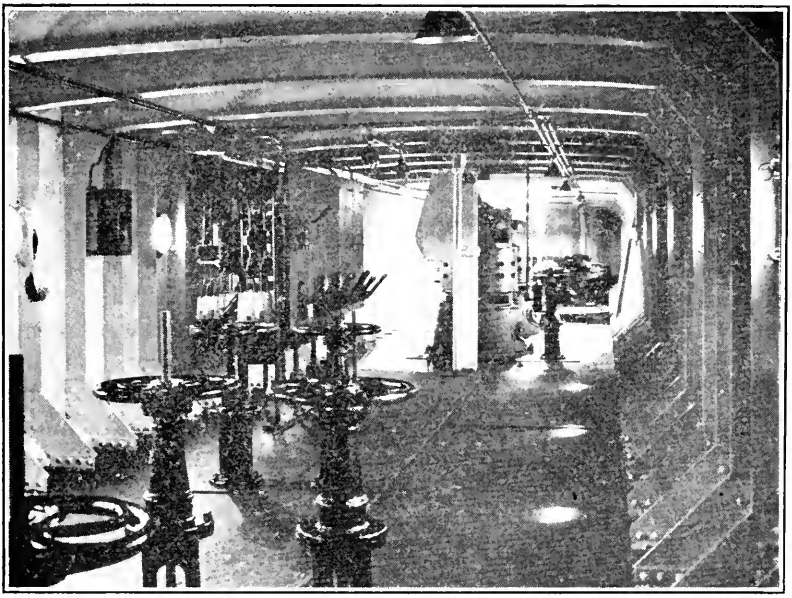

FIG. 5. CAISSON INTERIOR, MAIN DECK SWITCHBOARD, GATE STANDS AND MOTORS.

outer end and the other pair about opposite the intermediate sill. These are operated by 250-volt direct current, which is taken from the pump house installation, the alternating current there being converted by a rotary converter, and carried in a loop circuit completely around the dock. At manholes in the dock wall this circuit is provided with special junction boxes, so that connections may be made for direct current service to the capacity of the converter.

For securing the vessels, in addition to the large capstans, six hand-capstans are installed, three on each side of the dock,

and thirty-two cast-iron bollards were spaced between the capstans, so that there is a mooring post substantially at every 60 ft. along the dock.

ENGINEERS. — This work was commenced and continued under the direction and supervision of the writer. Mr. John N. Ferguson, assistant engineer, was resident engineer in charge of construction.

CONTRACTORS. — The contract for the construction of the dry dock itself and the pump well was awarded to the Holbrook, Cabot and Rollins Corporation. The pump house was built by the Weiss Construction Company, and the interior stairways and guide-gearing supports for pump shafts were placed by the Donnelly Iron Works, Inc. The pumping plant was furnished by the Worthington Pump and Machinery Corporation, the electrical apparatus furnished through that corporation by the General Electric Company. The gate valves of the plant were furnished to the pump contractor by the Chapman Valve Company. The dry dock sluice gates and caisson valves were manufactured by the Coffin Valve Company. The caisson was built by the Bethlehem Steel Bridge Corporation. The pumps in the caisson were furnished by the Worthington Pump and Machinery Corporation as sub-contractors, and the electrical apparatus sublet to the General Electric Company. The electric capstans were furnished by the Wellman-Seaver-Morgan Company, and the electrical work by the General Electric Company. The hand-power capstans were furnished by the Dake Engine Company. Power circuits for capstans and caisson were installed by Irving L. Matson. The traveling bridge crane was furnished by the Whiting Foundry and Equipment Company.

GENERAL UTILITIES. — The masonry of the dock wall and pump house has been liberally provided with ducts for electric cables, openings for water and air pipes, with the expectation of providing additional electric equipment and compressed air for working on vessels, but owing to the contract for transferring the dock to the United States Government these additional facilities will be installed by the Navy Department.

MEMOIRS OF DECEASED MEMBERS.

JOHN ALLEN GOULD.*

John Allen Gould was the son of John Allen Gould and Nancy P. (Hartshorn) Gould, both of Walpole, Mass. He was born in Newton Upper Falls on December 14, 1852, and died in the same town on May 18, 1919.

In his death this Society has lost one of its old and faithful members; modest, cheerful and helpful in every good cause, he never failed to respond to the calls of the profession. He was active and accomplished in his chosen specialty, and his influence for the right will not soon be forgotten.

In September, 1873, Mr. Gould entered the service of the Boston Water Department, and with that department he remained for twenty years. His first work for the city was in connection with the distribution system, and in all matters pertaining to that branch of water supply he became expert. When the Brookline Gas Light Company desired to secure the services of some one capable of directing their far-reaching plans in the Metropolitan District they engaged Mr. Gould to direct them in their work.

In 1896 his activities found a still wider field with the Boston Gas Light Company, and with that company he remained until his death.

As the years passed, Mr. Gould's usefulness broadened, and his growing reputation for good judgment and engineering skill brought greater rewards. He was frequently called in a consulting capacity in connection with enterprises outside of his regular employment, and these consultations extended at times beyond the borders of New England.

Mr. Gould was a member of the New England Water Works Association, American Gas Association and the New England

* Memoir prepared by Desmond FitzGerald and William A. Wood.

Association of Gas Engineers. He was also a director of the Boston Consolidated Gas Company and was past president of the Guild of Gas Managers of New England; he was also a member of the Engineers' Club of Boston, the Newton Club of Newton, and was actively interested in several coöperative banks.

GILBERT HODGES.*

Gilbert Hodges, son of Joseph and Rosabella (Stockbridge) Hodges, was born December 8, 1850, at East Brookfield, Mass., and died at Franklin, N. H., February 13, 1919.

He attended the high school in Cambridge, Mass., and at the age of sixteen went to sea, where he spent four years, being shipwrecked in midwinter and rescued on his twentieth birthday.

In 1871 he entered the office of his brother, Arthur Hodges, and studied civil engineering until 1874. He then went into the wholesale paper and stationery business, holding a position with a large firm in Springfield, Mass., from 1874 to 1876, and with another similar firm in Omaha, Neb., from 1876 to 1881.

His true vocation was evidently engineering, and in 1881 he gave up trade and entered the service of the Union Pacific Railroad, being employed in making surveys and locations in Colorado, Wyoming and Kansas.

From 1882 to 1887 he was connected with the Boston & Lowell Railroad in the engineering, bridge and building departments as draftsman, assistant engineer and assistant master of bridges and buildings.

Having served a thorough apprenticeship in the different branches of his profession, he opened an office in Boston, Mass., in 1887, for general engineering, making a specialty of railway engineering, and in this he built up a large practice. Among other works he had charge of the construction of the Arch Bridge, to replace the old Bussey Bridge on the Dedham branch of the Boston & Providence Railroad. A good part of his practice was devoted to electric railways in New England and the Middle States. From 1893 to 1900 he had as a partner Mr. Ephraim Harrington.

* Memoir prepared by Ephraim Harrington and A. W. Hodges.

Between 1900 and 1909, after severing his partnership with Mr. Harrington, he continued in practice, making a specialty of valuations and consulting engineering in connection with railway properties.

In 1909 Mr. Hodges gave up his office in Boston and moved to Franklin, N. H., where he was residing at the time of his death. During his residence in Franklin he was engaged in municipal and private engineering in that city and surrounding towns, having charge of extensive improvements that were made in the city of Franklin.

For a number of years previous to his death Mr. Hodges was consulting engineer for the Boston & Lowell Railroad in connection with matters pertaining to the lease of that road to the Boston & Maine Railroad.

Mr. Hodges was at one time a member of the Common Council of Medford, Mass., where he resided for several years, and also served a term as alderman in Franklin, N. H. He was a thirty-second degree Mason and a member of several societies, including the American Society of Civil Engineers and the Boston Society of Civil Engineers.

He was married in 1877 to Abbie Webster Hurd, who died in 1907, and was married again in 1911 to Gladys Colby who survives him. A son and daughter by his first wife and two sons by his second wife also survive him.

Mr. Hodges was conscientious and painstaking in working up and carrying out the details of any work that he had in hand. He was a loyal friend and an agreeable companion with both his business and social acquaintances, being ever ready to lend a helping hand or a word of encouragement.

LEWIS FREDERICK RICE.*

Lewis Frederick Rice, past president of the Boston Society of Civil Engineers, was born in the American House in Boston on May 17, 1839, and was the son of Lewis Rice, for many years the proprietor of this hotel and who died in 1877.

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* Memoir prepared by George S. Rice.

He was a descendant of the Pilgrim Edmund Rice who came from England in 1638 and settled in Sudbury, Mass., in 1639, and was the leading man on a plantation lying near unto Concord and shared by him and others in the early days of the foundation of this country. He was a selectman in the district in which he lived, and his services were often called upon in many capacities by the General Court in administering the affairs of the Colony.

The mother of Lewis Frederick Rice, Susan Augusta (Brigham) Rice, was a direct descendant of Thomas Brigham who emigrated to the United States from England in 1635 and settled in a part of Watertown, now a part of Cambridge, Mass.

True to the instincts of their English ancestors, the Rices and Brighams migrated to the different parts of this country, principally to New England; the Brighams going to Marlboro and Northboro.

In studying the published genealogies of the Rice family it is noticeable as a curious fact that while Susan Augusta Rice's son Frederick was descended from Edmund Rice by his first wife, Edmund Rice took as a second wife "Mercy," the widow of Thomas Brigham, and the son of Thomas Brigham married the granddaughter of Edmund Rice, the Pilgrim, and the two families were again reunited in the marriage of Lewis Rice and Susan Augusta Brigham. Both the Rices and the Brighams have been very patriotic since their arrival from England as emigrants, their descendants having had thrilling experiences in the Indian wars and serving with distinction in the Revolutionary War and the War of 1812.

Lewis Frederick Rice was educated in the Boston public schools, continuing his studies at a military school near West Point, and graduating at the Troy Polytechnic Institute, Troy, N. Y., as a civil engineer in 1858.

He immediately entered his professional career on the engineering staff of the St. Louis, Mo., Water Works, and later was division engineer on the Troy & Greenfield Railroad in Massachusetts.

At the outbreak of the Civil War he enlisted as first lieutenant in the Department of the Gulf, 19th Army Corps. He was

engaged, beside many minor engagements, in those of Forts Jackson and St. Phillips, Port Hudson, Fort Blakely, Mobile Bay, Mobile, Pattersonville, Yellow Bayou and operations around New Orleans.

He was made first lieutenant, 31st Massachusetts Infantry, February 20, 1862; promoted to captain October 10, 1863; commissioned major June 7, 1865; brevet major, U.S.A., March 13, 1865, " for gallant and meritorious services at Sabine Cross Roads, Cane River Crossing, Hudnots' Plantation, Moore's Plantation, Yellow Bayou, campaigns against Mobile," and was at the taking of New Orleans.

At the end of his three years' service in 1864 his regiment returned to Massachusetts, but a portion re-enlisted and Captain Rice returned to Louisiana with the battalion and was subsequently detailed for the exhaustive Red River expedition in which his conduct gained special mention and commendation.

At the end of his military service in 1865, he again engaged in the general practice of his profession in Boston.

He accepted a position as assistant engineer with the Reading & Columbia Railroad, which he soon relinquished to take a like position on the St. Louis Water Works, St. Louis, Mo.

He continued in St. Louis until the year 1871, when he returned to Boston to resume his practice of architecture and civil engineering.

His railroad work was continued later in the construction of the Perkimen Railroad of Pennsylvania and the Wills Valley Railroad in Alabama.

He was engaged on studies of an engineering nature, for the following New England cities and towns: Concord, N. H.; Framingham, Haverhill, Lawrence, Lowell, Plymouth, Watertown, Westboro in Massachusetts; and these included investigations for systems of sewerage for Framingham, Lawrence and Plymouth in Massachusetts. All of these investigations were made in his characteristic way, with the fidelity and accuracy inherent to him and due to his careful training and well-ripened experience.

In 1890 he entered the service of the American Bell Telephone Company and continued in their employ until the year

1908. As architect and civil engineer he superintended the construction of the company's buildings with a fidelity natural to him. He was faithful in his country's service, and was particularly interested in mingling in the gatherings of his former comrades and associates.

He was a member of the American Society of Civil Engineers; of the Massachusetts Society of Colonial Wars; of the Military Order of the Loyal Legion, and of the Order of St. John of Masons in Boston.

The activities of his military career in the Civil War led to his selection as historian of his regiment. He had been collecting a large amount of material for this work and the detailed research necessarily involved in the task was the source of great pleasure to him. This work, however, he was obliged to leave in an unfinished state, owing to his failing health, which occasioned his retirement from business. He died in Brookline, Mass., on April 12, 1909.

Besides his son Frederick Ellis Rice he was survived by his widow Caroline Elizabeth (Ellis) Rice, to whom he was married October 25, 1867.

He had two sons, Lewis and Frederick Ellis, but his eldest son Lewis died on April 2, 1899.

Throughout his life, accuracy and proper methods in life and thought were his predominating characteristics, and at all times he was interested in questions of the day, was outspoken in his views and independent in action.

Vol. VI NOVEMBER, 1919 No. 9

BOSTON SOCIETY OF CIVIL ENGINEERS

FOUNDED 1848

PROCEEDINGS

PAPER IN THIS NUMBER.

"The Industrial Unrest." By Charles H. Eglee.

Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

MINUTES OF MEETING.

BOSTON, October 15, 1919. — A regular meeting of the Boston Society of Civil Engineers was held this evening at Chipman Hall, Tremont Temple, and was called to order at eight o'clock by the Senior Vice-President, Leonard C. Wason.

There were sixty members and visitors present.

The record of the September meeting was read and approved.

The Secretary for the Board of Government reported that it had elected to membership in the grades named the following candidates:

Members — Robinson Abbott and Edward H. Clarkson, Jr.

Junior — Leo M. Brown.

The Secretary submitted for Mr. George S. Rice, the committee appointed for the purpose, a Memoir of Lewis Frederick Rice, a past president of the Society who died April 20, 1909. The memoir was accepted and ordered printed in the JOURNAL of the Society.

The death was announced of Edward S. Shaw, a member of the Society who died October 3, 1919, and by vote the President was requested to appoint a committee to prepare a memoir. The President has appointed Mr. Frank L. Fuller to serve as that committee.

The paper of the evening was by Charles H. Eglee, and was entitled, "The Industrial Unrest; a Short Study of Present Conditions in Industry, with Some Suggestions." Mr. Eglee presented some reasons why industrial relations are so greatly disturbed; he also described some methods that are now in operation to correct some of the present conditions and stated some principles that are being worked out in practice by our most advanced industrialists.

A most interesting discussion followed, in which Messrs. L. J. Johnson, F. B. Sanborn, J. R. Nichols, J. E. Titus, S. E. Thompson, E. S. Larned, R. A. Hale and others of the Society took part. Mr. G. Edgar Folk, Industrial Secretary of the Y. M. C. A. at Lawrence, also spoke interestingly.

Adjourned.

S. E. Tinkham, *Secretary.*

APPLICATIONS FOR MEMBERSHIP.

[November 15, 1919.]

The By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

CAIRD, ALEXANDER WINTON, Boston, Mass. (Age 24, b. Chicago, Ill.) Student at Worcester Polytechnic Inst. during year 1914–15; graduate of Mass. Inst. of Technology, January, 1918, civil engineering course, degree of S.B.; completed fifteen weeks' course in naval architecture at M. I. T. in May, 1918. From May, 1918, to August, 1919, with U. S. Navy Dept. at Boston Navy Yard; from September, 1919, to date, with Stone & Webster. Refers to H. P. Eddy, G. L. Hosmer, A. G. Robbins, G. E. Russell and C. M. Spofford.

DRAKE, CARL STANWOOD, Boston, Mass. (Age 44, b. Boston, Mass.) Educated in Boston public schools, including English High. From June, 1893, to February, 1894, rodman with sewer division, city of Boston; from April, 1894, to August, 1895, rodman and transitman with Aspinwall and Lincoln; from August, 1895, to August, 1898, rodman and transitman in charge of party with Boston Transit Comm.; from August, 1898, to date, instrumentman, assistant engineer and, at present, assistant district engineer with sewer service, city of Boston. Refers to T. F. Bowes, E. S. Davis, E. S. Dorr, C. R. Gow, E. F. Murphy and F. C. Shepherd.

LOVEJOY, FREDERICK ALDEN, Boston, Mass. (Age 52, b. Roxbury, Mass.) From 1886 to 1894, rodman, transitman and chief of party, on street widenings, etc., with Boston City Surveyor; in 1894, in charge of field work, preliminary surveys for Metropolitan Boulevard, Stoneham and Wakefield; in 1895, in charge of plane table party on topography of Blue Hills Reservation; from 1895 to date, chief of party, first assistant to district engineer, and, at present, assistant district engineer with sewer service, city of Boston. Refers to H. K. Barrows, T. F. Bowes, J. E. Carty, E. S. Dorr, W. E. Foss and L. B. Manley.

MONAGHAN, JOHN EDWARD LAURENCE, Boston, Mass. (Age 42, b. Arlington near Oldham, England.) Graduate of Mass. Inst. of Technology 1906, degree of S.B. From 1906 to 1915, assistant engineer; from 1915 to 1916, assistant district engineer; and from 1916 to date, district engineer with sewer service, city of Boston. Refers to T. F. Bowes, J. E. Carty, E. S. Dorr and D. P. Kelley.

THOMAS, HOWARD CUSHING, Newton Highlands, Mass. (Age 26, b. Cambridge, Mass.) Graduate of Mass. Inst. of Technology, 1915, civil engineering course. During summers of 1912 to 1916, inclusive, transitman, chief of party and draftsman with W. W. Wight, C.E., Wellesley Hills; from 1915 to 1916, assistant in civil engineering department, Mass. Inst. of Technology; during summer of 1917, assistant to supervising engineer, Childs Co., New York, N. Y.; from 1916 to 1917, instructor at Coöperative Engineering School, Northeastern College, Boston; from 1917 to 1918, asst. professor of civil engineering at Northeastern College; from June, 1918, to September, 1919, draftsman and designer with Fay, Spofford & Thorndike; from September, 1919, to date, designer with Kearns Const'n Co. Elected a junior,

January 27, 1915, and now desires to be transferred to grade of member. Refers to W. W. Bigelow, C. A. Farwell, F. L. Fuller, H. F. Sawtelle and C. M. Spofford.

TOZZER, ARTHUR CLARENCE, Brookline, Mass. (Age 40, b. Lynn, Mass.) Graduate of Dartmouth College, 1902, degree of B.S., and of Thayer School of Civil Engineering, 1903, degree of C.E. From February to September, 1902, transitman for contractors on dry dock of Boston Navy Yard; from May, 1903, to January, 1904, engineer with French & Bryant, Brookline; from January, 1904, to January, 1905, assistant superintendent on pneumatic foundation work with Foundation Co. of New York; from January to November, 1905, assistant superintendent with S. Pierson & Son, Inc., on East River Pennsylvania R. R. tunnels; from November, 1905, to date, with Turner Const'n Co., of which he is now vice-president and general manager in charge of all New England work; from April, 1918, to July, 1919, was executive manager in charge of construction of Army Supply Base, Brooklyn, N. Y. Refers to F. H. Fay, C. R. Gow, C. T. Main, H. C. Robbins and H. F. Sawtelle.

TRASK, WARREN DUDLEY, Somerville, Mass. (Age 33, b. Augusta, Me.) Graduate of Univ. of Maine, 1908, civil engineering course. From 1908 to 1909, engaged in timber surveys in northern Maine; from 1909 to 1910, draftsman and chief of party on irrigation project at Valier, Mont., for Conrad Water & Land Co.; from 1910 to 1911, draftsman and instrumentman with U. S. Reclamation Service on Sun River project at Fort Shaw, Mont.; from 1911 to 1912, city engineer of Augusta, Me.; from 1913 to 1914, Street Commissioner of Augusta, Me.; in charge of highway and sewer construction and maintenance; from 1915 to 1916, Dep. Treas. of state of Maine; from 1917 to date, assistant engineer with Fay, Spofford & Thorndike, with exception of three months in 1918 with Monks & Johnson, as inspector on construction work at Squantum Destroyer Plant. Refers to F. H. Fay, C. R. Gow, B. A. Rich, H. F. Sawtelle, S. H. Thorndike and C. M. Spofford.

LIST OF MEMBERS.

ADDITIONS.

BROWN, LEO M. .... 24 Garfield St., Detroit, Mich.
DICKSON, ARTHUR D. .... 149 Austin St., Cambridge, Mass.
FOX, WALTER S. .... 101 Milk St., Room 914, Boston, Mass.

CHANGES OF ADDRESS.

ALLEN, CHESTER S. .... 25 Duffield Rd., Auburndale, Mass.
ALLEN, ELMER F. .... 30 Evans Way, Boston, Mass.
BROWN, H. WHITTEMORE .... University Club, Madison, Wis.
BURRILL, NATHAN C. .... 3 Central Pl., Newburyport, Mass.
COBURN, WILLIAM H. .... 10 State St., Boston, Mass.
COGHLAN, JOHN H. .... 100 Appleton St., Arlington, Mass.
EWING, WILLIAM C. .... 3517 Clifton Ave., Cincinnati, Ohio.

Foley, Ernest L. .... 550 Centre St., Newton, Mass.
Ford, Arthur L. .... 25 School St., Danvers, Mass
Hastie, Frank B. .... Engineer School, Camp A. A. Humphreys, Va.
Hobson, George F. .... Computing Div.,
Supervising Architect's Office, Treasury Dept., Room 439, Washington, D. C.
Jackson, Dugald C. .... 387 Washington St., Boston, Mass.
Johnson, George A. .... Colonel, U. S. A.,
Const'n Div., 7th and B Sts., Washington, D. C.
Leavitt, Albert J. .... 28 Stevenson Ave., Everett, Mass.
Osborn, John F. .... 314 Harvard St., Cambridge, Mass.
Richardson, Edward B. .... 195 Mountfort St., Brookline, Mass.
Savage, J. Dana .... 1551 West Broad St., Stratford, Conn.
Shorrock, John W. .... 153 East 86th St., New York, N. Y.
Skillin, Fred B. .... Post Office Bldg., Room 415, Brooklyn, N. Y.
Snow, Leslie W. .... 143 East 39th St., New York, N. Y.
Taylor, Philip W. .... 74 Barnard Ave., Watertown, Mass.
Thorpe, George H. .... 504 Edgewood St., Hartford, Conn.
Tucker, Edward A. .... 101 Milk St., Boston, Mass.
Tucker, Herman F. .... 616 11th St., North, Seattle, Wash.
Turner, Charles C. .... 104 Elmwood Ave., Wollaston, Mass.
Van der Pyl, Edward .... Care Norton Co., Worcester, Mass.
Wade, Clifford L. ..... Wadsworth Chambers, Suite 33, Cambridge, Mass.
Walker, Frank B. .... 1 Beacon St., Boston, Mass.
Wansker, Harry A. .... 76 Quint Ave., Allston, Mass.
Webb, DeWitt C. .... 24 Old Beach Rd., Newport, R. I.
Weston, Arthur D. .... 141 State House, Boston, Mass.
Whitney, Ralph E. .... 98 Mountfort St., Suite 6, Boston, Mass.
Woodbury, Stanley W. .... 9 Barstow St., Salem, Mass.

DEATHS.

Grover, Edmund .... October 20, 1919.
Manley, Henry .... October 28, 1919.
Wood, Irving S. .... October 20, 1919.

EMPLOYMENT BUREAU.

The Board of Government maintains an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society rooms two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

Men Available.

489. Age 30. Student for three years at Univ. of Nevada. Has had about six years' experience, including two years on railroad location and construction for Western Pacific R. R., one year as inspector and transitman on reënforced concrete bridge construction, and one year on canal and railroad work in Mexico; has done military mapping with regular army engineers; served one and one-half years as officer in artillery of U. S. Army. Desires position as transitman, levelman, inspector or foreman. Salary desired, $30 per week.

490. Age 20. Has high school education supplemented with I. C. S. course in civil engineering and three months at Harvard Univ. in S. A. T. C. Has had four years' experience as rodman, draftsman and instrumentman on general civil engineering work, including land court surveys and subdivisions and hydrographic and topographic surveys; has also served as inspector on dredging work. Character of immediate work immaterial; desires to work eventually into position as engineer or assistant on reënforced concrete construction.

491. Age 55. Graduate of Mass. Inst. of Technology. Has had wide experience in municipal work, chiefly on sewers, parks, bridges and special investigations; has also had one year on topographic work with U. S. Geological Survey and about four years with firm of consulting engineers on studies and designs for system of sewers and storm water drains, on concrete bridge design and on concrete buildings and wharves. Would prefer position in Boston or vicinity. Salary desired, $225 per month.

NOTES FROM ENGINEERING COUNCIL.

Engineers in the 1920 United States Census.

As a result of Engineering Council's request to the director of the Census, the National Service Committee has been successful in effecting a reclassification of engineers so that all technical engineers will be listed as such, separately and distinctly from the non-technical engineers. Thus, the next census will bring an enumeration of all technical engineers together as one unit under the main headings of Civil, Mechanical, Electrical and Mining. Architects will also be enumerated separately.

This will enable the engineering profession, the Government or any other interested organization or person to know exactly how many technical men there are in the United States and in each state. Under separate headings the enumeration will also include non-technical engineers (stationary engineers, locomotive

drivers and other enginemen); but there will be no group heading for the latter, and in order to get the totals of non-technical engineers (enginemen) all of the various grades of this classification would have to be sorted out and added.

The National Service Committee has been working with the Bureau of Census in listing positions as they are commonly returned from the enumerators of the Census, so that only strictly technical engineers will be included in the list. Thus, there will be a cog for the technical engineers in the big census counting machines, to catch cards that are punched with their classification, and we shall know definitely for the first time just how many technical engineers there are in this country.

Of course it is understood that there are many practitioners of engineering who do not ordinarily classify themselves under any one of the four headings given above, and others there are whose practice extends into more than one field. More numerous headings or more complex classification is impractical in the work of the Census Bureau. It is believed that every professional engineer can, with very little violence to the facts, place himself in one of the broad classes adopted for the 1920 Census: Civil, Mechanical, Electrical, Mining. With the general coöperation of all engineers along these lines, a much better enumeration should result than in any preceding census.

LIBRARY NOTES.

Book Review.

"Vital Statistics: An Introduction to the Science of Demography," by George Chandler Whipple, professor of sanitary engineering in Harvard University; member of the Public Health Council, Massachusetts State Department of Health. New York, John Wiley & Sons, Inc., 1919. Flexible binding, xii+517 pp., 4.5 x 7 in., 63 figures. $4.00.

Reviewed by Robert Spurr Weston.*

As the author states in his preface, "This book is written for students who are preparing themselves to be public health

*Of firm of Weston & Sampson, Consulting Engineers, Boston.

officials." It defines statistics and shows the student how to apply the statistical method to vital facts, — how to express his meaning by figures, tables, curves and diagrams.

The three introductory chapters which pertain to the arithmetic and graphics of statistics, while not specifically interesting to engineers trained in their use, are nevertheless worth reading for their clearness of statement and fertility of illustration.

The fourth chapter describes the methods of enumeration and census taking, and the following chapter on "Population" is of value to sanitary and other engineers whose work considers the growth of communities.

The chapters which deal with death rates and the causes of death, both general and specific, and the methods of analyzing and valuing the same, are well done, as are also short chapters on "Life Tables" and the methods of insurance actuaries. While, near the beginning of his book, Professor Whipple instructs the reader in simple counting, near its end he elucidates the theories of probability and correlation, in an effective and practical way.

The style of the book is excellent. It is clear, and it teaches. Furthermore, the illustrations from so wide a range as Jaques' soliloquy from "As You Like It" and the report of the physician who gave "vital statistics" as a cause of death, introduce interest and even humor into a subject which, treated by less skillful hands, might increase the reader's own morbidity and introduce a new name in nosography.

The book is designed to teach, and does not pretend to be a compendium of vital statistics. However, it uses statistics of permanent value as illustrations of various methods, and in no case does it leave a subject with the reader without referring him to various sources of information, notably a bibliography in the appendix, which latter also contains drafts of model state health laws and a table of five place logarithms.

The chief accomplishment of the author, apart from bare statements of facts, is his skill in explanation, and the book ought to better the work of the vital statistician and hasten the passage of registration laws in those twenty-one states where not even deaths are recorded. The reviewer would like to see included

in a book of this kind descriptions of the map-and-pin and other mechanical methods of showing current facts. It would also seem judicious to include a table of cubes and squares, because the reader who has "forgotten" his logs. has probably "forgotten" his roots.

Recent Additions to the Library.

U. S. Government Reports.

Abstracts of Current Decisions on Mines and Mining, September to December, 1918. J. W. Thompson.

Explosives and Miscellaneous Investigations.

Financial Statistics of States, 1918.

Magnesium in 1918. Ralph W. Stone.

Motor Gasoline: Properties, Laboratory Methods of Testing and Practical Specifications. E. W. Dean.

Recovery of Zinc from Low-Grade and Complex Ores. Dorsey A. Lyon and Oliver C. Ralston.

Statistics of Railways in United States for 1916.

Vapor Pressure of Lead Chloride. E. D. Eastman and L. H. Duschak.

War Minerals, Nitrogen Fixation and Sodium Cyanide. Van. H. Manning.

(The) War with Germany: Statistical Summary. Leonard P. Ayres.

State Reports.

Massachusetts: Annual Report of Gas and Electric Light Commissioners for 1918.

City and Town Reports.

Boston, Mass. Summary of Remarks of Guy C. Emerson at meeting of North and South Shore Street Superintendents' Clubs, June 20, 1919, on subject of Bituminous Pavements.

Brockton, Mass. Annual Report of Board of Survey for 1918.

Brockton, Mass. Annual Report of City Engineer for 1918.

Brockton, Mass. Annual Report of Sewerage Commissioners for 1918.

Fall River, Mass. Annual Report of Watuppa Water Board for 1918.

Lowell, Mass. Annual Report of Commissioner of Water Works for 1918.

New York, N. Y. Annual Report of Board of Water Supply for 1918.

St. Louis, Mo. Annual Report of Water Commissioner for 1918.

Miscellaneous.

Carnegie Endowment for International Peace: Year Book for 1919.

Concrete Institute (London): Transactions: Vol. VI, Parts I and II; Vol. VIII; 1918. Gift of L. H. Allen.

LIBRARY COMMITTEE.

VAIL LIBRARY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

BY DOROTHY G. BELL, LIBRARIAN.

THIS library was collected in England by Mr. Dering, who became very much interested in electricity and had his bookseller send him everything relating to that subject. The collection comprises about twenty thousand volumes, including pamphlets and dissertations. There are books in many modern languages as well as early and rare books in Latin, some bound in vellum, and others in beautiful leather bindings. The rarities include such books as Gilbert's "De Magnete," 1500 (first edition); Aepinus's "Tentamen theoriæ electricitatis et magnetismi," 1759; Cabeo's "Philosophis magnetica," 1629. All subjects relating in any way to electricity are included, and in nearly every case are complete to the year 1912. Nearly all of the books relate to electricity, magnetism and electrical engineering, including alternating and direct currents, railways, telephone, telegraph, wireless, etc. In addition there are books on electro-chemistry, electro-metallurgy, electro-therapeutics, world expositions and electrical congresses. There is also a very interesting collection on the early developments in aviation.

In 1912, President Theodore N. Vail of the American Telephone and Telegraph Company purchased the library and very generously gave it to the Massachusetts Institute of Technology for the Electrical Engineering Department, first to be catalogued and then to be brought up to date. Recent books on electricity and electrical engineering are being added to make the library of the greatest possible use to the students in the Institute and all others interested in the study of electricity. The original collection is now catalogued, and about a thousand new books have been added. The Institute has given a large room in the main building for the Vail Library, and from thirty to forty readers may be accommodated at one time. Sixty-three periodicals are kept on file, many of which are not taken elsewhere in Boston.

The Vail Library is independent of the main Institute Library, and is a unique collection. It is the only electrical engineers' library of its kind in New England, and, as far as is known, the third in the United States. Such a collection of books on electricity and electrical engineering, offering as it does a wide and interesting field for research and study, is invaluable to Technology. The library is open to the public for reference and research.

The library itself is very attractive in appearance. Each book is numbered in gold with the seal (Vail Library) stamped above the number. The front cover of each book contains the Vail Library bookplate. This bookplate was designed by Sidney L. Smith, a noted Boston engraver, and bears a very fine portrait medallion of Mr. Vail. The words "Vail Library" are engraved above the portrait, and below is the inscription "Gift of American Telephone and Telegraph Company, Massachusetts Institute of Technology, 1912."

This gift is thus not only a great asset to the Institute and to its students but also to Massachusetts and its citizens.

Vol. VI NOVEMBER, 1919 No. 9

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

THE INDUSTRIAL UNREST: A STUDY OF PRESENT CONDITIONS IN INDUSTRY, WITH SOME SUGGESTIONS.

By Charles H. Eglee,* Member of Boston Society of Civil Engineers.

(Presented October 15, 1919.)

I am glad to be among you again after two years' sojourn in the sunny South. Glad to be free from the governmental restrictions and war exertions, and back in Boston where the wicked cease from troubling and the police can take a rest.

During this time a change has taken place in the feeling of all men who dispense the weekly pay-roll, as well as all those who receive the weekly envelope. It is a permanent change.

A change so great and an unrest so widespread that President Wilson has called to Washington fifty-seven representative men and women who are endeavoring to determine a remedy. If these representatives can unite upon a principle that can be generally accepted by the nation, the details of method and action can be worked out by the people, and the beginning of industrial peace is in sight. If not, each individual industrialist must work out his own problem in his own establishment, in his own way.

Those who have followed the profession of engineering know that all true results are based on fixed principles that are unchang-

* 715 Tremont Temple, Boston, Mass.

ing. The principle or law of the aëroplane always existed, but its practical application had to be proved by human effort, by experiment, by waste of money and material and even loss of life. The slide rule which we use every day always existed in principle and law, and this principle is absolute, yet ignorance or carelessness in the application of the law will cause trouble, mistakes and confusion. It is the province of engineers to discover the true principles of life and to devise correct methods of application; and, moreover, to endeavor to demonstrate their value in progress, in easier living conditions and in money value. An engineer must always study the commercial value of a dollar bill. For that reason I should like to talk to you about principle — not expediency; the right and wrong of our present conditions in industry, rather than a poultice or plaster to the visible symptoms of unrest; and I trust that a discussion may follow that will develop some profitable and progressive ideas.

We seem never to have proceeded with the labor question along the lines of underlying principle; always our decisions have been dictated by expediency or what to do at the moment to keep the wheels turning. Usually this has resulted in a fight and a compromise, with no one satisfied, and both sides preparing for a renewal of the struggle. The history of labor troubles since the days of the Pharaohs has been the same, and the end is not yet; though the way is gradually being made more clear.

Mr. R. J. Caldwell, special industrial commissioner to England from the United States, says:

"Signs of unrest in the ranks of labor are healthy signs of national growth. Peoples who are content with venison and a string of wampum do not survive.

"But the signs of unrest are equally signals of menace to that class of employers who refuse to grow, and who persist in the fallacy that labor is a commodity, instead of accepting the laborer as a human being."

This man cannot be called a crank or a *pro* labor advocate. He is president and owner of large New England interests, employing many men and women. He is one of the captains of industry, who have built up the nation's big business and who have been forced by the confusion of to-day to realize

that it is their distinct province to search out the cause and apply the remedy; for, failing this effort on the part of business leaders, the mass, who only want what they can get at the present moment, will be led by radical agitators into all kinds of excesses and destruction. We read and we see so much of disorganizing effort and propaganda that we imagine all labor to be in the wrong attitude. This is not true. The majority of men are more conservative; they look to the future and to the welfare of wife and child, and hope for an old age free from worry and strife. What we see and hear is the noise of an irresponsible minority; very noisy and very numerous, but still a minority.

We must remember the three great fears of the workingman, — the same fears we all have perhaps at times, but that have been with him always: The fear of sickness, the fear of unemployment, the fear of a poor old age. The self-seeking agitator preys upon these fears and teaches him two untruths — two lies that continually make trouble: First (I quote from the anonymous pamphlet, "The Truth about the Labor Question"), "Wages control all conditions," and, second, "Employers control wages"; and there is every appearance to the wage earner of truth in these statements. He knows his wages control his standard of living, and he knows that singly and alone he has no control over the wages paid him. He can take them or go without. It never occurs to him to think that his wages are controlled by natural laws of economics; of supply and demand and international trade. We cannot expect him to understand that his standard of living depends upon the efficient production of industry. He ought to know better, of course, but such things have never been explained to him and it is not difficult for him to believe that as capital controls wages it is a heartless tyrant and greedy oppressor. Here is the seed of Bolshevism, the dreams of madmen, — but not so mad but millions of men believe in them. The wonder is not at the number of converts, rather the wonder is that there are not more.

We are studying to ascertain what men really want. The ready answer is, more money; but the psychologists tell us this is not so. They have studied the basic impulses and instincts

of man, and have learned that there are two inseparable underlying instincts: First, the reproduction of the race, stronger than honor, life or morality; from this proceeds all other incentive to production. It is the joy as well as the necessity of creating something. Next is the instinct of worship; all men look up to something above themselves, an idea, a love, a force or principle or personality; — the psychologists tell us that a man who knows these instincts consciously or unconsciously, and can work upon them through others, is bound to lead men.

Men think they want money; they really want a chance for self-expression — to do the thing they *want* to do. Labor wants a voice in the management of its own life, — a method of self-expression and development, — not more wages, not shorter hours, least of all does it want any kind of coddling or uplift or charity. It doesn't want to be *given* something. It wants to be recognized as a man, a human being with thoughts and aspirations and ambitions, and it will *not* be bought and sold as a commodity or a slave or a menial; that day has gone forever, — that day of the sweatshop and the tuberculous tenement; that day of the despotic boss whose will was law.

Men in general are fair. Men are square dealers. If this were not so all business and society would be in ruins. Business men are finding this a pretty safe general rule, and many a big business is built up around this principle. Our national system of credit and our laws are based upon the character of the community. And yet, in most of our previous dealings with the labor question, we have missed the fundamental belief of every man in his own manliness. We have not believed, really believed, in a man's right to determine his own life and its conditions; his right to express his own opinions, of working out his own destiny often by mistakes and wrong methods; and as a result we have educated labor as a class; a class which when it takes its employer's money must be more or less subservient to that money. It won't do any longer in this country — Americans are fair-minded. Men, all men, want a square deal. That's all.

The principle of a square deal, however, has never been standardized. Clear, true justice of man to man has never been realized, for it is a constant progression or evolution, always

influenced by the opinion of the mass based upon its knowledge of what is right and what is wrong, this knowledge being gained by education and experience. Little by little we learn great truths and make them part of our united life. No man can truly say he is absolutely right in his idea of a square deal toward others, for our ideas of justice are changing and growing constantly toward higher and better levels as our vision broadens. Every progressive employer to-day is trying to give his men a square deal. He means to and he tries to, but he cannot always study his situation carefully enough — does not employ trained expert advice, and is often unwilling to depart from the traditions of the past or spend money and increase his overhead expense in order to install the methods of to-day. The big men are doing it; the smaller establishments in time will be obliged to do it. The more rapidly labor is educated in true economic lines, the more the benefits of industrial peace are made manifest, the sooner will Bolshevism be forgotten. The laborer has recently learned a great truth: that high wages defeat their own object and strikes do not help to reduce the high cost of living, for the increase to the consumer is greater than the increase of his wages; and that *he is the consumer.* This is a new, broad, illuminating viewpoint for labor; something it never thought of before.

The labor agitators, the radical Bolshevistic men who seek to overthrow all order and government, are sensing a change and are moving heaven and earth to get control of organized labor and prostitute it to their selfish ends, while the confusion of war conditions is among the people; but the sober element of the ranks of labor is beginning to think a little, and every time a stand is made based upon a true principle the mass of the people endorse that stand. The policemen's strike is an example. The principle at stake was the denial of the right to desert a public trust by a public official, and while the union tried to cloud the issue, Governor Coolidge and Commissioner Curtis stood firm and found the whole Commonwealth of Massachusetts as well as the sober element in the nation, strong in their support.

In the steel strike, Judge Gary is firm in his stand that 15 per cent. of unionized labor cannot dictate to 85 per cent. of the

Steel Company employees, and he would do wrong to permit it. The country and the loyal, satisfied employees of the company are upholding him, and Mr. Foster, the I. W. W. leader, will fail, and another lesson will be learned.

When men are so perverted in their ideas that they will elect such a representative as the marine workers sent to the United States Shipping Board it is time for our wisest leaders to heed carefully the sentiments he expresses. He said:

"I will not consent to any change in policy. I do not care how much suffering or inconvenience may come to anybody; as the more hardship there is inflicted on the people the better will be our chance of winning.

"I have no regard for the civil service law; the laws are of no use to workingmen, anyhow; the only laws that are any good are those passed by the unions, and can be repealed by the unions when necessary, without being subject to any interpretation by the courts."

There is only one answer to such statements. The answer of constituted authority; the answer given to Boston and Omaha, and ready for any other city or section that offends the law of the land. No leader, politician or agitator can teach such doctrine and endure while the majority of men are fair-minded — and the majority of men in this country *are* fair-minded. Such ideas are part of the madness of war.

Sir Robert Horne, the British minister of labor, says:

"The industrial unrest was due mainly to the following causes: The long strain of war, the nervous effect produced by the extreme industrial efforts of the nation, the disturbance of normal economic life, the rise in the cost of living, and in a certain measure an absorption into English thinking of the revolutionary movements of Europe."

The same is true in this country; and, in our difficult period of readjustment to normal conditions, the disorganizing and destructive forces of society, always discontented, have taken advantage of their opportunity. The answer is: Force when necessary to protect society and in support of the truth, and a constant progressive education based on principle instituted by our industrial leaders each in his own establishment in concerted, coöperative action with his men.

The number of systems, plans and experiments now being tried with the idea of giving labor a square deal are many and various; most of them good as systems, many of them working well in some establishments, while none of them *as a system* has proved a panacea for industrial woe; for in the last analysis it is the management behind the system and the principle at its foundation that really counts. Those based upon enduring principles accepted by all parties to the coöperative effort of production and with a personality behind them that will not yield to expediency, pull, influence or temporary advantage, are successful; all others are useless, and any system which is merely camouflage or a game of jollying the boys, is a disaster from the beginning. The much-talked-of shop committee is both damned and praised. The technical journals use considerable space in its discussion. Many experts say a shop committee is a sure method of delivering the management of the shop into the hands of radical labor leaders. But, what *kind* of a shop committee is under discussion? What is it for? What principles does it stand for? After these points are determined we shall think carefully about a shop committee, for it is like dynamite, — very useful indeed in its proper work, very destructive if carelessly or ignorantly handled.

It would be interesting if we had the time to review some of the various systems being tried in different establishments: Pension and old age insurance; investment in the stock of the company; education of foremen; scientific selection of workers; efficiency production with time and motion study; task and bonus systems; industrial democracy; personnel and service work. All of these are helpful and effective.

One very necessary part of the education of foreign labor is furnished by community service, a civic expansion of the War Camp Community Service. A national campaign is now in progress, and the manufacturers of Massachusetts have just pledged their quota of $200 000 to the national fund of $2 000 000 for the training of expert workers in local community fields, in Americanization, and the setting up of a backfire against anarchy and Bolshevism. To-day in New York a regular system of education in anarchy is in progress among children; in Sunday-

school they are taught hymns of hate against capital, and all the lies of Bolshevism are instilled into the receptive young minds. I am informed that there is such a school, or schools, in a city near Boston. I do not know that this is true, but if it *is* true in that city or any other New England city it is high time to look to it — now! for there is certain, sure danger ahead.

Community service and proper housing conditions go hand in hand, and the housing corporations are putting scientific ideas into community practice. Men must have homes; real homes, where wife and children can live in some degree of self-expression; where they can be a part of their town and take pride in their citizenship and so help to allay this red terror of Europe that we have let loose upon ourselves. We did not see the danger when we took in every kind of cheap labor and then exploited it to our own gain. We did not realize that the pauper we fed would bite the hand that gave it food — yes, and take the life blood of its benefactor. It is time now to halt, to soberly think of what America is and what we should like to have America become, — and then see that every one in America is a real American before we let any more red-handed trouble into our beloved land. Better keep out a few good ones, better make a mistake or two and debar a few friends, than to admit a flood of unknown peoples and allow them to do as they like after they are here. Never again will this be permitted.

Industrial peace and prosperity means the education of the employer no less than the education of the employee; capital and labor have the same interest and must learn this through efficient management; together must they work out our industrial salvation along lines of principles that each can accept. The first is justice, a square deal, — the basic principle of civilization and production; secondly, coöperation. The quality of success in team work is so well known that it needs no comment. Then service, production, — the joy as well as the necessity of creating something and of creating it together. Every man or woman must give some kind of service before he receives any payment whatever. The merchant must have goods collected before he can sell them. The professional man must educate himself in some efficient service

before his value is demonstrated. The laborer must finish his day's work before he is paid. It is a new word, "service," but when men realize that their wealth is created only by human effort applied to some natural gift, then they will know that the wealth is in the thing produced and every curtailment of production means loss of wealth, no matter how individual effort may be expressed in terms of money. If Germany is really and truly committed to ten hours of productive labor in every day, and is able to accomplish as much in one hour as the other nations, while we and our allies work eight hours and hope to work only six, we can now stop all worry and await our certain doom as calmly as may be.

The question naturally arises: Can these principles of justice, coöperation and service be practically applied to produce results? It is being done. The system is in successful operation with necessary forms, details and machinery; but woe betide the man who attempts it with form and machinery, but without the deep conviction of the principle. Men cannot be fooled. The simple mind of the simple man recognizes sincerity. He looks for a life of example and a strict adherence to a principle he himself advocates; also he wants to help work this out together with his boss and his fellow worker. No, the people cannot be fooled! The public is quick to recognize any enterprise that protects the right of the consumer, and the industry based on justice, coöperation and service will recognize those rights and will profit accordingly. In the last analysis it is the public that must be justly and efficiently served, and the day is rapidly approaching when no harmony between capital and labor will be permitted which has for its object the squeezing of the last possible dollar from the consumer. The public is patient and long-suffering, but when forced to act in self-defense, the punishment of the offenders is certain.

There is an establishment in this vicinity in which several thousand men and women are enjoying industrial happiness, earning good pay, participating in some manner in certain profits, and where there has never been any industrial difficulties. The business has grown until its name is a household word in New England. All because of the wisdom and the just

management of its founder and his methods of educating his helpers. They have every kind of service and personnel work and welfare activity, in all of which the worker has a voice. The management does not believe in debasing its helpers by giving them something. It gives them an *opportunity*, and together they are building an organization that is a quiet example of justice, coöperation and service. The public recognizes this and is doing its part to make the business very profitable.

I saw the working of these principles quite recently in a shipyard employing five hundred men, — the most irresponsible, uneducated, willful bunch of men ever collected together. They were gradually brought to such coöperative effort that production was greatly increased, costs materially reduced, the labor turnover ceased almost entirely, and while other yards were advertising and searching for men, there were always men who wanted to work in this yard; when a labor leader tried to unionize these workers he was put out by the men themselves, and in fact the life of that entire little town was changed; all without raising wages, paying bonuses or giving anybody anything. This meant work; one solid year of untiring, consistent effort in one direction; but it paid. Such effort will pay in any establishment; it may take a year, or two or three; it may cost some money in the beginning, but the result will pay liberally and will pay in money returns to workers and to management.

The president of the Philadelphia Rapid Transit Company says that company can afford to run cars with a five-cent fare because of the coöperative effort of the company officials and their employees. One of the steel company subsidiaries furnished a statement from its employees protesting against the steel strike, and it is a fact worthy of thought that ninety per cent. of the Americans employed remained loyal to their work, and the noisy, uneducated foreign element was manipulated by the radical agitator. The vice-president of this company recently made an address on "Getting Our Men to Help Us Manage." Coöperation does not mean the turning over of the management to the will of the workmen — for what is coöperation but the ideas and ideal of one man worked out by the coöperative effort

of his helpers, — an autocracy of principle in a democracy of endeavor? That is real coöperation.

Any worthy enterprise under a management big enough to carry out such principles will naturally attract trained helpers to execute the necessary details, and will pay everybody connected with it enough to demonstrate the value of industrial peace. Capital, management and workers will be unionized within the works, the labor turnover reduced, the disaffected and disgruntled taken care of by pressure from their fellows; the workers will learn that wages are paid from production and not from profits; much and in time perhaps all interference from the outside will be prevented, the executives relieved from a good deal of unnecessary detail and pressure with opportunity to use the time so saved in progressive work, and better and more loyal men and women will be developed.

This cannot be condemned as the dream of an idealist, for the principle is at work successfully in too many localities, and we have just witnessed a national example of the education of a whole people on a basis of principle. The morale of our army and navy, our labor and production, was based on principle; Honor, Duty, Country, spread by posters, by word of mouth, by public print, by regulation and discipline; *our* Honor, *our* Duty, *our* Country, — an autocracy of principle in a democracy of effort. If one half the money now spent in unproductive advertising could be spent in a similar effort for Justice, Coöperation and Service, we would have no more troublesome labor problems. If the membership of the present Industrial Conference at Washington can unitedly proclaim such principles and institute an educational propaganda to spread them among the people, they will accomplish a noble work, but if they develop a class war — if a certain class, any class, shall dominate, the struggle will but grow more bitter and more determined.

There is no good reason why a thousand or a million men and women cannot be educated to economic truth when they know they are personally interested in that truth. Once get the idea thoroughly into the minds of men and women that they are paid from production and not from profits or capital and it will not be necessary to worry over industrial troubles in the United

States; but men must have an opportunity under a just leadership to work this idea out themselves. Most Americans are born in Missouri. They must be shown.

The National Industrial Conference Board sent five representative employers of labor to Europe to study industrial conditions after the war. Their final report is about ready to be issued. An interim report was made in August, and among its concluding observations are the following:

"Behind all mechanical devices for bringing employers and employees together there lies the necessity of first reaching a right attitude of mind. So far it has not been shown that joint councils or joint industrial conferences in themselves can, or have, brought about the desired attitude of mind. In themselves they are no remedy for discontent.

"Without doubt the main recommendation of your Commission to American industrialists is that each employer should regard it as his personal duty to establish direct and cordial relations with his workers.

"For us the point is that everything depends upon the spirit of humanity and sympathy which animates both parties to the wages contract.

"The employer must take the lead; much in the way of leadership is expected of him. If he is really at heart trying to raise the standard of living, as he ought, of his employees, he should moreover be occupied not only with questions of wages or material rewards but with matters which will cultivate the intelligence, morals and character of men. Granting this attitude of mind, then, there must be a corresponding point of view on the part of labor if any permanent and peaceful adjustment is to be accomplished."

The Hydraulic Pressed Steel Company of Cleveland, Ohio, in its published advertisements says:

"Four years ago we said to our people,—'We are rapidly coming to a time when the phrase "Capital and Labor" will be forgotten. All those connected with a business will be banded together for the success of that business because each one connected with it will be getting that part of the success to which he is entitled.

"'The working out of this principle in our case has not been easy. We can, however, report these practical benefits,—a quality and economy of productions we had not known before, a growing measure of profit, and last but not least, a feeling of mutual content far beyond our hopes.

" 'To all those whose interests lie in industry we can say with confidence born of experience that the principle of a square deal with your own people based upon a thorough knowledge of all conditions affecting them, works; and works well.

" 'Men are square. This is not faith with us. It is Knowledge — Knowledge gained from day to day contact — Knowledge gained from the experience of hundreds — Knowledge common to every employer and to every workman who has gotten below the surface of things — who has come to know men as men, all moved by the same human impulses. Men are square — make no mistake of that.

" 'Our suggested solution is that Capital, Labor and Management in each industry work together for the protection of that industry and in every manufacturing plant appreciate that their real, vital interest is in the protection and fair division of the profit of that particular plant.

" 'We no longer think of detail as any matter for concern. Understanding, — mutual understanding, — mutual consideration and mutual respect, — these, and these only, make everything else possible. We have found men to be fair whether they contribute money, brains or muscle to the day's work.' "

DISCUSSION.

SANFORD E. THOMPSON.* — I was in Cleveland last spring, at the time of the so-called Bolshevist riots, and a good many men marched through the streets. One of the most interesting things was to watch the attitude of the people on the sidewalks, — the rank and file of them. They were simply enraged at the marchers. I was told that in some sections they almost tore some of them to pieces. So I cannot but feel that in our country the real problem is not so much Bolshevism — the real problems are those such as Mr. Eglee has described. One of the most discouraging features of the labor movement in the past has been the direct aim of the labor unionists to restrict production. Now, one of the interesting features is the fact that, theoretically at least, many of the labor men — the labor leaders — are appreciating that for their own interest production should be increased. It is up to us all to develop and maintain this spirit. Of course, in many cases this is a theory, not practice; yet

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theory does count in the long run. And we have this anomaly, — when business is brisk and every one is busy it is easy to believe in the value of increased production; it is easy to appreciate the fact that unless a man increases his production he can't have an increase in wages — that production is an absolute necessity for keeping up wages and keeping down the cost of living. But it is very hard, nevertheless, for the worker to live up to it because the demand for his service is so great that there is little incentive for even a fair day's work. On the other hand, just as soon as business drops, the theory is harder to appreciate. The workman thinks of his neighbor who has just been discharged because work is scarce. "There isn't enough work to go round," he says, to himself; "I'll reduce my production, and let the other fellow work too"; and unless we are right on the job with vigor and persuasion we shall have a return to the old idea of the workman that he will get more money if he works slowly.

Industrial coöperation, which Mr. Eglee has discussed, is certainly one of the most promising signs of the times. I listened a few days ago to the leader of the Rock Island Arsenal employees, where they are developing a plan for representation. He was very enthusiastic over the success of the plan. At the same conference representatives were present from a large private industry in the Middle West, where there is a similar plan in operation.

But along with all this is another essential. No matter how good an organization you may have, unless your factory is run in good shape you will not be able to be just to the men. It is a question how permanent will be the representative coöperation unless along with it comes the development of production methods that will give a square deal to the worker. For example, take an ordinary shoe shop. There you will find almost every day certain workers in one line or another laid off because there is not enough work; that is, the particular styles being made on that day cannot keep all the workers busy and so they are laid off. We see the same thing in other industries, — this unemployment within employment, — due to variation in the kind of work, which means lack of work in certain operations and also often lack of proper distribution of materials to the workers.

So there is idle time and loss of money to the workers, — for in many factories they are not paid for idle time, — and loss also to the factory through shortage of materials and faulty methods. And thus we must consider along with any plan, such as that of representation in the management, the question of production. These two things must be carried on together in order to ensure satisfactory industrial relations.

G. EDGAR FOLK.* — I am merely a visitor but have been greatly interested in the discussions. There are two things very clear in my mind. I believe that the men in industry to-day — I mean the heads of industry (at least the mass of them) — are absolutely honest in desire and endeavor to give a square deal. I believe the mass of workingmen, when you get down to the real man, can be trusted; but there is a class I cannot understand. They are not the ignorant leaders, but apparently well-bred and well-educated men, men who have had the advantage of college training and post-graduate work. Here is a statement I recently cut out of one of the bulletins headed by such men:

Our Industrial Union:

With all the coöperative and English classes and stamps and buttons, don't forget WHAT OUR UNION IS FOR! Our FIRST BIG JOB IS TO BEAT CAPITALISM and give all workingmen LIBERTY. When the boss is nice to you, don't be fooled. HE IS STILL YOUR BOSS! AND we must get rid of bosses. If you know of some department in your mill where the workers are dissatisfied, where they want to strike, tell us at the office.

— *Amalgamated Textile Union Bulletin No. 4.*

How are we to meet this problem?

R. A. HALE.† — We have in Lawrence, one of the large textile centers, 85 per cent. foreigners, possibly 45 to 50 different languages, and a very mixed population. The various corporations have coöperated within a few years and contributed a large fund towards forming industrial classes, which seems to be a step in the right direction towards the solution of the industrial problem. They have very large classes and are very enthusiastic. They are working along the line of getting in close contact with

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† Principal Assistant Engineer, Essex Water Power Company, Lawrence, Mass.

the men, which seems to be the practical way to do it. I know of one of the large mills that only runs at about 75 per cent. of its capacity, because it cannot get sufficient help, and the others are affected in a similar manner. They are all taking pains to educate the people and make better employees, with remarkable success. Now, with respect to the agitator. Two clergymen — one from Newton, I believe — came to Lawrence a short time ago and attempted to give these foreigners some advice, which was very ill-timed and did more towards prolonging the difficulties than it did towards settling them. But if the men are let alone they will do good work, and they are anxious to work. While the strike was on, a few hundred succeeded in keeping out thousands who wanted to go to work. A system of education has to be carried on among the employees by the corporations, and an interest manifested along the lines suggested by Mr. Eglee. The Lawrence Young Men's Christian Association has these industrial classes in charge through its industrial secretaries, and is accomplishing excellent results. Monthly meetings for the overseers and managers are held each month at the Y. M. C. A., at which, after the dinner, addresses are made by men who have specialized in some special lines of industrial work and general management.

J. P. Snow.* — The Society is certainly to be congratulated on being privileged to listen to Mr. Eglee's masterly presentation of this great subject, the greatest national question before our country at the present time.

America has helped in an effective way to win the war that should prevent future wars for settling national differences, and we now have the opportunity to show the world how to settle the industrial warfare that at present disturbs all civilization under the name of the labor question.

The address of the evening, and most of its oral discussion, is upon the line of general analysis of a theoretical or sentimental nature, very fundamental and essential but not concrete and applicable to a particular case. I shall try, herein, to show how the essence of the principles laid down by the speakers can be applied to industries in a businesslike way.

* Consulting Engineer, 18 Tremont Street, Boston.

It is conceded by all that capital and labor are both essential in any enterprise. In addition to these two interests, there must be consumers of the product if commercial success is the objective. These three interests, capital, labor and consumers, are recognized in the Industrial Conference referred to by the speaker of the evening as in session at Washington, under the group designations of owners, employees and the public.

If these parties have joint interests in a given enterprise, what is more logical and just than that they should function as copartners, real acting partners so far as their several interests shall appear? Let us examine these interests and see if a rational working basis can be deduced.

The interests of capital demand security of investment and a return commensurate with the risk; the commercial rate of interest if the security is perfect, more than this rate if chance is a factor. This return is the true wage of capital. The interests of labor demand a wage commensurate with the expenses of living on the accepted scale for the grade of labor under consideration. The interests of the consumers demand a product true to name and at a minimum reasonable price.

To insure that each of these demands is equally honored and provided for, it seems necessary that each interest should participate in the management, and no better basis of representation is apparent than that of equality.

If the enterprise is a commercial one whose objective is profit, equity requires that the two producing interests, capital and labor, should share in this profit according to the just interests of each. It is absurd for the consumer to share in profit, because, first, an individual's share cannot be delivered to him, and, second, it would be like taxing him for the purpose of paying back to him a moiety of his tax.

The basis of division of profits to these two interests should be proportionate to the sacrifice of each; and the measure of this sacrifice is the wage of each at the agreed-upon scale. The investment may be small compared to the pay-roll, like an express business; or it may be large, like a steel-making plant. Hence no division except on a pro-rata wage basis can be equitable.

Some writers claim that brains go with money to constitute

capital, but brains and money are in distinct classes. If the capitalist's brains go to the aid of the industry, with or without money, their value to the business should show on the pay-roll and be there accounted for exactly as should the workman's skill.

The fundamental principles, then, of a proper labor system are, sharing of management between owners, employees and the public, and division of profit between owners and employees according to businesslike and equitable schemes. This is radically different from our present system of hiring labor, and must be called a new labor system. Its two principles of partnership in management and in profits involve the surrender by the owners of privileges that are so fixed by custom as to appear righteous and justifiable. A close and fair analysis, however, shows that they are no more inherently just than is the right of slave-holding or the divine right of kings.

Our present system of hired labor is a direct derivation from, and an improvement on, the abject slavery of two thousand years ago in Rome. The serfdom of the feudal age, the farm tenant system of England and the hired labor of the present are all generically alike, while the partnership system advocated above is radically different. It realizes the Christian principle of the brotherhood of man to a degree as complete probably as our present state of culture will assimilate.

"There is no difference between hiring labor and buying labor," a prominent writer recently stated. I do not agree with him in this, but I do contend that they are in the same class, that they are both outgrown by our present stage of civilization and that partnership is the corner stone of the new order.

Although dimly realized by us because we are at the plexus of events and have no perspective, civilization is passing from one stage to a higher one. Among the milestones marking this change are the elimination of international war and the passing of the system of hired labor to the more humane system of partnership.

Privilege always dies hard. It required the French Revolution to extinguish the privilege of the Bourbons, the wars of Cromwell and of William III. to free England from the privilege

of the Stuart kings, the long struggle for reform to kill the rotten borough system of the English Parliament, and our Civil War to eliminate the privilege of the slaveholder in this country. The awful World War shows the cost of taking privilege from the Hohenzollerns and the military caste begat by the Teutonic knights of the Crusades. Will American owners of capital demand a price like these for the privilege of management and profits held by them since industry began, or will they peacefully pool their rights as did the thirteen states in 1787? And will the laboring class accept fair partnership or will it stand out for bloody Bolshevism which always leads to nowhere?

As furnishing a concrete example of the partnership principle set forth above, I submit an abstract from a plan for the reorganization of our railroads formulated by Prof. William G. Raymond, of Iowa State University. The problem consists of two phases, finance and labor; the latter only will be quoted here.

"Let a federal holding company be organized with a federal charter, which company is to absorb all administrative functions of the present Interstate Commerce Commission and of all state commissions so far as interstate railroads are concerned, and is to be allowed to function without respect to the Sherman Law or other conflicting laws which for the purpose of this organization are repealed. The organization of this holding company is described later. * * *

"The holding company will control the properties as one system, making proper rental or sale adjustments when facilities of one property are used jointly by two or more.

"Each separate property is to retain a separate management except as to jointly used facilities which shall have a joint management in which the several properties concerned shall be represented.

"These separate managements shall operate the separate properties to develop the best that can be developed in each, all, however, subject to the general policy control of the holding company. The principal office of each separate property shall be in some city reached by the main line of the property.

"On the directing staff of each separate property there shall be in addition to an ex-officio director from the holding company equal representation of owners of holding company preferred participating stock representing the stock of the particular property, and employees. The representatives of the employees

shall be so chosen as to give equal representation to train operatives, station and clerical operatives and maintenance of way and equipment operatives. The stockholders shall choose their directors, and the several groups of operatives shall choose each their respective directors. Preferably, there shall be but seven directors for each property, six chosen as above indicated and one as hereinafter provided for.

"A standard basic wage scale for all classes of employees shall be fixed by the holding company directors from year to year, adapted to the several sections of the country respectively in which the employees may serve or live. For this purpose the wage districts of the country shall conform to the operating districts hereinafter mentioned.

"The wage scale shall be stated in multiples of the lowest hourly rate. Some latitude is to be given to provide for the recognition of individual efficiency in each grade of service in each class. Change from year to year need be only in the primary unit except as inequities of assigned multiples may appear. The basic scale would be devised having in mind the division of profits provided for later.

"The standard wage shall be fixed in the first instance by the holding company directors in consultation with an equal number of delegates from the following railroad service departments:

"*a*. Trainmen, including road enginemen and firemen, and yard engine crews and men.

"*b*. Station and clerical service, including station agents, telegraphers, clerks, accountants, general office assistants and all other help not otherwise mentioned.

"*c*. Maintenance of way and equipment.

"The details of the selection of these representatives of labor are to be arranged, but the three classes are to have equal representation. * * *

"After consultation with respective separate property boards, rates shall be fixed by the directors of the holding company so as to be fair for each service in each district but such that the aggregate earnings of all properties of the country shall equal as nearly as may be the following sums:

"*a*. The aggregate of all costs of operation including wages and material and supplies for operation and maintenance, and including also proper allowance for depreciation for those items not properly maintained by the replacement method from year to year, and including also the cost of administration of the holding company.

"*b.* All interest on the funded and other debt of the separate properties.

"*c.* The stated interest on the preferred stock of the holding company.

"*d.* A surplus emergency fund allowance of five per cent. of the sum of items 1, 2 and 3 to be collected only until the surplus fund shall equal ten per cent. of the par value of the preferred participating stock of the holding company and thereafter to be collected at a rate only sufficient to maintain the surplus emergency fund at approximately ten per cent. of the preferred participating stock par value.

"*e.* A profit of not less than ten per cent. and not more than twenty per cent. of items 1, 2 and 3, calculated to be about fifteen per cent. in the beginning and to increase toward the higher limit as the sum of 1, 2 and 3 per unit of service is decreased and to decrease as the sum of 1, 2 and 3 per unit of service is increased, and in such proportion to be worked out as will penalize extravagance and reward economy.

"The net earnings of all properties shall be paid directly into the treasury of the holding company, each quarter. Deficits shall be reported and shall be met by draft on the surplus fund until such time as rates may be adjusted or the authority of Section 12 is exercised.

"The properties as such are to be tax exempt, except for special improvements from which they receive chief benefit, such tax payment being charged to capital. (This is based on the fact, not theory, that under the best modern public control the public always pays the taxes in the form of rates for service.) The holders of stocks and securities and the wage earners are to be subject to their usual local and federal income taxes and moneys and credit taxes.

"The holding company shall distribute cash equivalent to the net earnings as follows:

"Semiannually to pay the interest on the separate property bonds and other obligations.

"Semiannually to pay the stated interest on the holding company preferred stock.

"Semiannually to charge the surplus fund.

"Quarterly to pay the profits.

"The profits shall be distributed to the several properties in proportion to their net earnings, and the directors of the separate properties shall distribute the profits accruing to their respective properties to the stockholders and employees in a just proportion measured by the cost of money and the adjusted receipts of labor. The intent is to have each class share in pro-

portion to what it contributes. The stockholders contribute the cost of the money used, i.e., interest on debt and preferred stock, and the employees contribute service measured by what they receive at the basic wage rate.

"The surplus fund may be drawn upon from time to time or built up as may be necessary to maintain the profits between the minimum rate of ten per cent. and the maximum rate of twenty per cent. above mentioned; but the surplus fund shall never exceed ten per cent. of the par value of the holding company preferred stock for more than five consecutive years. The surplus fund to the extent deemed wise by the directors of the holding company is to be invested in approved quickly convertible securities, say government bonds. The earnings of the surplus fund as invested shall be added to the fund and when it appears to be growing regularly in excess of the maximum amount, rates shall be reduced accordingly. * * *

"The federal company shall be organized by twenty-four directors chosen as follows:

"Twelve to be appointed by the President of the United States, by and with the consent of the Senate, to serve for life or until permanently incapacitated, provided none shall serve after reaching his seventieth birthday. These to represent the people as patrons of the road. A long term less than life may be better, with retirement in rotation.

"Twelve men to represent the railroad interests and chosen, six by the organization of railway owners and six by employees. Two of the latter group are to be chosen by an organization of all trainmen and yardmen; two by the general operating officers of the companies to represent the clerical staff and station men, or by an organization of these men; two by an organization of the maintenance of way and maintenance of equipment employees.

"The terms of office of these twelve railroad representatives shall be the same as those of the members appointed by the President.

"Any member may be removed for cause from time to time by the appointing authority concerned. Vacancies will be filled as they occur, by the appropriate appointing authority.

"Each director of the corporation shall have one vote on all questions coming before the corporation."

At the sesquicentennial celebration of Dartmouth College, a few days ago, Justice W. P. Strafford, of the Supreme Court of the District of Columbia, in speaking of the issues before the country, said:

"We now stand face to face with a new riddle of the Sphinx. The question it propounds is one that we must answer if free government is to survive. That question is, how are the masses of men and women who labor with their hands to be secured out of the products of their toil what they will feel to be and will be in fact a fair return? Until we can answer that question we shall have no peace; and if we fail to answer it we shall have revolution.

"The question is not one that faces America alone; it faces Britain; it faces France; it faces Italy; it has torn Russia into pieces. Let us hope that our own country may be the one to find the true solution of the riddle, and thereby bring safety and freedom to the people of all lands."

The rule of the Theban Sphinx was that each passerby must guess its riddle, and if the guess was incorrect he died; if the riddle was correctly answered, the Sphinx itself died. Our sphinx is the labor question; the answer to its riddle is partnership based on the square deal and the Golden Rule, the brotherhood of man, the very essence of the Christian religion. If this answer is given, the question is solved and the problem dies, but if selfishness prevails and the answer is like Pharaoh's to the Children of Israel, red revolution may be our lot.

[Professor Johnson, Mr. Nichols, Mr. Titus, Mr. Larned and Professor Sanborn also spoke on the present industrial unrest and on measures which might be taken to better the situation.]

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BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PROCEEDINGS

PAPERS IN THIS NUMBER.

"Future Opportunities and Obligations of Engineers." George W. Fuller.

Memoir of deceased member.

MINUTES OF MEETINGS.

BOSTON, October 29, 1919. — A special meeting of the Society was held this evening at Chipman Hall, Tremont Temple, and was called to order at 7.40 o'clock by the President, Leonard Metcalf.

There were 155 members and visitors present.

The President announced that the meeting had been called at the request of the Society's Committee on Compensation of Engineers, to give to members, and other engineers, who are interested in the subject, an opportunity for free discussion of views which would be helpful to the committee.

He first called on Col. Charles R. Gow, the chairman of the Society's Committee on Compensation of Engineers. Colonel Gow explained that the committee's object in calling this meeting was, if possible, to obtain first-hand knowledge from those who had direct experience with the present conditions and situations relating to engineering remuneration, and that he was sure the committee would give careful consideration to the suggestions offered, with the hope that a report might ultimately be submitted which would suggest some reasonable and constructive

lines along which the Society can act to improve the welfare and standing of its members and the community.

The President then introduced Mr. Charles Whiting Baker, consulting editor of the *Engineering News-Record*, and a member of the Committee upon Classification and Compensation of Engineers appointed by Engineering Council.

Mr. Baker, after giving a brief account of the organization and work of Engineering Council, presented some most interesting statistics relating to what has been generally called the high cost of living, but is more truly a question of the change in value of the dollar.

The next speaker introduced was Mr. Percival H. Mosher, president of the Civil Engineers' and Inspectors' Union of Boston, who spoke particularly of the aims and objects of the organization he represented.

Mr. Beardsley Lawrence, the local secretary of the American Association of Engineers, and a member of this Society, was the next speaker. He explained the purposes for which the American Association of Engineers was founded in 1915, and said that it took for its objects the raising of the standards of ethics of the engineering profession and the promotion of the economic and social welfare of engineers.

The meeting was then thrown open to a general discussion, in which the following took part in addition to the previous speakers: Mr. William G. Addis, of the Engineering Department of the Massachusetts Highway Commission; Mr. Walter C. Voss, of the Wentworth Institute; Mr. Wanberg, Mr. Rice, and others, not members of the Society. The following members of the Society also took part in the discussion: President Metcalf and Messrs. D. C. Jackson, J. A. Lockhart, S. H. Thorndike, H. F. Bryant, H. P. Eddy, H. K. Barrows, G. T. Sampson, O. D. Rice and others.

Colonel Gow closed the discussion and moved a vote of thanks be extended to Mr. Baker and Mr. Mosher, who are not members of the Society, for their kindness in coming to assist us in this problem.

Adjourned.

S. E. TINKHAM, *Secretary.*

Boston, November 12, 1919. — A special meeting of the Society was held this evening in its rooms and was called to order by the President, Leonard Metcalf, at 7.40 o'clock. There were 25 members and visitors present.

In opening the meeting the President stated that it had been called at the request of some of the members, to give an opportunity to discuss, further, the paper read by Gen. R. C. Marshall at the annual meeting last March, on "Cost-Plus and Other Forms of Contract."

In the interesting discussion which followed, the following members took part: Past Presidents C. F. Allen, F. W. Hodgdon, C. R. Gow, C. M. Spofford and R. A. Hale; and Messrs. E. S. Larned, R. J. Rowe and others. Messrs. P. A. Shaw and H. E. Wheeler, of the L. H. Shattuck Company of Manchester, N. H., and Mr. Victor H. Clark, of the Stone & Webster Corporation of Boston, also contributed most interestingly to the discussion.

President Metcalf, after discussing the question before the meeting, presented for Mr. E. S. Dorr a new form of contract which is a modification of the cost-plus contract.

At 10.30 the meeting adjourned.

S. E. Tinkham, *Secretary.*

Boston, November 19, 1919. — A regular meeting of the Boston Society of Civil Engineers was held this evening at Chipman Hall, Tremont Temple, and was called to order at eight o'clock, by the President, Leonard Metcalf.

There were present 97 members and visitors.

The record of the regular October meeting and of the special meetings held October 29 and November 12 were read and approved.

The President for the Board of Government reported that it had elected to membership in the grade of member, Henry Chisholm, Ernest Palmer Giles and Frederick Elmer Jones.

The Secretary presented the report of Mr. Frank A. Marston, the committee appointed to prepare a memoir of Fred Eugene Sauer, Jr., a member of the Society who died January 30, 1919, and by vote it was accepted and ordered printed in the Journal of the Society.

The President announced the deaths of the following members of the Society: Past President Henry Manley, who died October 28, 1919; Edmund Grover and Irving S. Wood, both of whom died October 20, 1919. The President was requested by vote to appoint committees to prepare memoirs. The committees are as follows: On memoir of Henry Manley, Messrs. C. Frank Allen, Edward W. Howe and Laurence B. Manley; on memoir of Edmund Grover, Messrs. Richard A. Hale and Arthur L. Plimpton, and on memoir of Irving S. Wood, Mr. William D. Bullock.

The President then presented Mr. George W. Fuller, of New York, a member of the Society, who gave an interesting address entitled, "Future Opportunities and Obligations of Engineers."

A brief discussion followed on the subject matter of the address.

The remainder of the meeting was devoted to a general discussion on the work of the Society and what could be done to awaken the interest of the younger portion of our membership.

After passing a vote of thanks to Mr. Fuller, the speaker of the evening, the Society adjourned.

S. E. TINKHAM, *Secretary.*

BOSTON, November 5, 1919. — The Sanitary Section of the Boston Society of Civil Engineers held a special meeting this evening in the Society Library, Tremont Temple. The meeting was called to order by the Vice-Chairman, Henry A. Varney, at eight o'clock.

The subject of the evening was "Submerged Outfall Sewers."

Mr. Hiram A. Miller, chairman of the special committee on "Methods of Design and Construction and Results of Operation of Submerged Pipe Lines for Outfall Sewers," described several outfall sewers constructed in New Jersey by Mr. Marshall R. Pugh, of Philadelphia.

Mr. William F. Williams, engineer for the Massachusetts Commission on Waterways and Public Lands, and formerly city engineer of New Bedford, spoke on the construction and operation of the New Bedford outfall sewer.

Mr. Clarence A. Moore, assistant engineer, Metropolitan Water and Sewerage Board, described the Metropolitan outfall sewers.

Mr. William T. Barnes discussed the coefficients of discharge for the Salem, Mass., outfall sewer as determined by several measurements of flow, made during the last few years.

Mr. Erastus Worthington described the outfall sewer and pumping station at Swampscott, Mass.

The meeting adjourned at 9.50 P.M.

Members present, 31.

JOHN P. WENTWORTH, *Clerk.*

APPLICATIONS FOR MEMBERSHIP.

[December 15, 1919.]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

BUDD, GEORGE, JR., Boston, Mass. (Age 31, b. London, England.) Received general education at Whitgift College and City of London College; served four years' apprenticeship to Wantage Engrg. Works, England; received technical education at City and Guilds Technical College, London, graduating in 1910. From 1911 to 1912, draftsman with Deane Steam Pump

Co.; in 1912, draftsman with Coburn Trolley Track Mfg. Co.; from 1912 to 1913, draftsman with Bergen Point Iron Works, Bayonne, N. J.; from 1913 to 1914, engineer with Haaman & Co. Iron Works; from 1915 to 1916, engineer and designer with Donnelly Iron Works, Lowell; from 1916 to 1917, structural designer with Lamson Conveyor Co.; from 1917 to 1919, Senior Master Engr. in charge of topographical office with Am. Exped. Forces; is now designer and checker on reënforced concrete and steel with Harry M. Hope Engrg. Co. Refers to W. W. Clifford, C. M. Durgin, E. P. Rankin, M. R. Sumner and J. L. Tighe.

Danforth, George Clapp, Augusta, Me. (Age 38, b. Gardiner, Me.) Graduate of Mass. Inst. of Technology, 1903. From 1903 to 1909, on miscellaneous municipal work, including sewers, water works and roads; in 1909, on timberland topographic surveys; from 1910 to 1911, on railroad location; from 1912 to 1914, assistant engineer with Maine Water Storage Comm.; from 1914 to 1917, assistant engineer with Maine Public Utilities Comm., in charge of Water Resources Div.; from 1917 to 1919, capt., Engrs., Am. Exped. Forces, serving in France and Germany; is now chief engineer, Maine Water Power Comm. Refers to H. S. Boardman, H. K. Barrows, T. W. Clark, C. H. Pierce, and W. H. Sawyer.

Green, Howard Whipple, Woonsocket, R. I. (Age 26, b. Woonsocket, R. I.) Graduate of Clark College, Worcester, 1914, degree of A.B.; received degree of S.B. in sanitary engineering from Mass. Inst. of Technology, 1916; received degree of S.B. in sanitary engineering from Harvard University, 1916. From June to September, 1916, rodman and instrumentman, and from September, 1916, to March, 1917, cost engineer with H. Koppers Co. of Pittsburgh, Pa., on by-product coke oven job for National Tube Co. at Lorain, Ohio; from March, 1917, to September, 1919, chemist with Panama Canal Commission in Canal Zone, during which time he acted as chief bacteriologist, Miraflores Water Purification Plant, and engineer of tests, Municipal Div.; from June, 1919, to date, sanitary engineer with International Health Board of Rockefeller Foundation on malaria control through antimosquito measures. Elected a junior December 15, 1915, and now desires to be transferred to grade of member. Refers to C. B. Breed, G. L. Hosmer, L. J. Johnson, Dwight Porter, C. M. Spofford and G. C. Whipple.

Hall, William Wheeler, Jr., Worcester, Mass. (Age 23, b. Malden, Mass.) Student at Worcester Polytechnic Inst. from 1914 to 1917; from 1917 to 1919, in U. S. Army; is now senior at Worcester Polytechnic Inst. in sanitary civil engineering course. Refers to C. M. Allen, A. W. French and H. C. Ives.

Sheils, Henry Connor, Roxbury, Mass. (Age 25, b. Boston, Mass.) Graduate of Mass. Inst. of Technology, 1915, civil engineering course; did post-graduate work at M. I. T. in 1916. During summers of 1907 to 1913, with Coughlan and Sheils, general contractors; during summers of 1914 and 1915, with Coleman Bros., contractors; from 1916 to 1917, with National Waterproofing Co.; from December, 1917, to March, 1919, in U. S. Naval Aviation Corps; from March, 1919, to date, general contractor. Elected a

junior March 21, 1917, and now desires to be transferred to grade of member. Refers to J. W. Howard, L. J. Johnson, Dwight Porter, J. T. Scully, C. M. Spofford and J. A. Starr.

Stackpole, Miner Reginald, Boston, Mass. (Age 30, b. Sanford, Me.) Took I. C. S. courses in surveying and mapping and in municipal engineering during years 1907 to 1911; graduate of Univ. of Maine, 1917, civil engineering course, degree of S.B.; from 1909 to 1911, rodman and chainman for various parties on variety of work in Maine; during summers of 1912 and 1913, engaged in general land surveying and municipal engineering in Sanford, Me.; during summers of 1914 and 1915, transitman, and during summer of 1916, resident engineer with Maine Highway Comm.; from June, 1917, to July, 1919, junior engineer, and from July, 1919, to date, assistant engineer in Water Resources Branch, U. S. Geological Survey. Refers to H. S. Boardman, N. C. Grover, E. O. Hathaway, C. H. Pierce and D. M. Wood.

LIST OF MEMBERS

ADDITIONS.

Chisholm, Henry.....................16 Bayswater St., East Boston, Mass.
Mirick, George L.....................64 Hemenway St., Boston, Mass.

CHANGES OF ADDRESS.

Bean, Thomas W.,
Care of Turners Falls Power and Electric Co., Turners Falls, Mass.
Breen, Anthony A. ....112 Central St., Somerville, Mass.
Bunker, Page S.....Superintendent of Parks and Forester, Fitchburg, Mass.
Casey, John J..........................19 Fenno St., Roxbury, Mass.
Clarkson, Edward H., Jr...Care of State Board of Health, Little Rock, Ark.
Davis, Harold F.............................Forest St., Reading, Mass.
Elkins, Clayton R.. Central Union Depot Bldg., Room 308, Cincinnati, Ohio
Foster, Willard M...................................Nashua, N. H.
Hammond, N. LeRoy ....141 State House, Boston, Mass.
Iverson, Thomas.........................15 School St., Boston, Mass.
Reeds, Clarence.........................904 Main St., Hartford, Conn.
Rich, Malcolm..............................28 John St., Ilion, N. Y.
Robinson, Byron A. ....Bellows Falls, Vt.
Sawtelle, Harry F.,
Care of Lockwood, Greene & Co., 245 State St., Boston, Mass.
Thorpe, George H.......................904 Main St., Hartford, Conn.
Umstead, Charles H.. ...Treasury Bldg., Room 400, Washington, D. C.

DEATHS.

Shaw, Edward S.......................................October 3, 1919.
Stearns, Frederic P..................................December 1, 1919.

EMPLOYMENT BUREAU.

The Board of Government maintains an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society rooms two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

Men Available.

447. Age 37. Graduate of Brown Univ., 1903, civil engineering course, degree of S.B. Has had fifteen years' experience as draftsman, including three years on railway maintenance, nine on sanitary and drainage engineering work, one as mechanical draftsman, and two as draftsman and instrumentman on village, property and topographical surveying. Desires position as draftsman and assistant to consulting engineer. Salary desired, $100 per month.

492. Age 46. Has had twenty years' experience, chiefly on design and construction of dredging machinery, including bucket, dipper and hydraulic types; has also had experience on pumps, engines, hoisting machinery and foundations. Desires position as draftsman or erection engineer. Salary desired, $200 per month.

493. Age 37. Student for three years at Harvard University. Has had four years' experience on railway location and construction in British Columbia and two years on land and timber surveys as rodman, levelman, topographer, etc.; served as line sergeant, Engrs., with Am. Exped. Forces. Desires topographical work. Salary desired, $75 per month and expenses.

494. Age 34. Graduate of University of Pennsylvania, 1909, degree of B.S. in civil engineering. Has had about ten years' experience, chiefly on railroad work, including one year on general railroad maintenance, two years in charge of yard and dock construction, over three years in direct charge of all maintenance and construction on about 250 miles of city and interurban electric railway, about two years as assistant engineer on extensive hydro-electric development for railway and light company, and more than a year in selling special track work for iron and steel company. Desires to locate in New England, preferably in or near Boston.

495. Age 21. Has grammar school education supplemented by six months at Northeastern College. Has had about three years' experience as transitman and chief of party on survey work, and about six months as leveler on construction of railroad yard. Desires position as transitman or chief of party. Salary desired, $25 per week, if work is near Boston.

496. Age 37. Received education in public schools and from I. C. S. course. Experience has been chiefly in surveying, but has done some construction work; was on housing work with U. S. Shipping Board for a time. Desires position as transitman. Salary desired, $160 per month.

LIBRARY NOTES.

Recent Additions to the Library.

U. S. Government Reports.

Clays and Shales of Minnesota. Frank F. Grout.

Coal in 1917: Part A, Production; Part B, Distribution and Consumption. C. E. Lesher.

Coke and By-Products in 1916 and 1917. C. E. Lesher and W. T. Thom, Jr.

Decline and Ultimate Production of Oil Wells, with Notes on Valuation of Oil Properties. Carl H. Beal.

English Port Facilities. F. T. Chambers.

Mineral Resources of Seward Peninsula, Alaska. George L. Harrington.

Mining and Mineral Deposits in Cook Inlet-Susitna Region, Alaska. Stephen R. Capps and others.

Mining in Fairbanks, Ruby, Hot Springs, and Tolstoi Districts, Alaska. Theodore Chapin and George L. Harrington.

Mortality Statistics for 1917.

Natural Gas and Natural-Gas Gasoline in 1917. John D. Northrop.

New Science of Industrial Physiology. Frederic S. Lee.

Oil Shale in Western Montana, Southeastern Idaho, and Adjacent Parts of Wyoming and Utah. D. Dale Condit.

Standards for Measuring Efficiency of Exhaust Systems in Polishing Shops. C.-E. A. Winslow and others.

Tight and Slack Cooperage Stock Production in 1918. Franklin H. Smith and Albert H. Pierson.

Water-Supply Paper 485.

State Reports.

Pennsylvania. Annual Report of Commissioner of Health for 1915.

City and Town Reports.

Cambridge, Mass. Annual Report of Water Board for 1917–18.

New Orleans, La. Semi-Annual Report of Sewerage and Water Board, December 31, 1918.

Miscellaneous.

Canada, Department of Interior, Natural Resources Intelligence Branch: Natural Resources of Manitoba, Saskatchewan and Alberta.

Chlorination of Water. Joseph Race. 1918.

Conveyance and Distribution of Water for Water Supply. Edward Wegmann. 1918.

Johnson's Materials of Construction. Rewritten by M. O. Withey and James Aston; edited by F. E. Turneaure. 5th ed. 1919.

Shore Processes and Shoreline Development. Douglas Wilson Johnson. 1919.

Water Purification. Joseph W. Ellms. 1917.

Wood and Other Organic Structural Materials. Charles Henry Snow. 1917.

LIBRARY COMMITTEE.

Vol. VI DECEMBER, 1919 No. 10

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications

FUTURE OPPORTUNITIES AND OBLIGATIONS OF ENGINEERS.

By George W. Fuller,* Member Boston Society of Civil Engineers.

(Presented November 19, 1919.)

This is a period of readjustment. The Great War has brought this about for many men and many things.

Exigencies of the military establishment in its various ramifications have shown weaknesses and inadequacies of earlier arrangements.

War experiences show the need of more efficient organization and of the supercession of old-fashioned programs by better ones.

This applies practically to all groups of men, and spreads out into numerous fields of activities.

For some time engineers have been striving with this situation. Like other groups of citizens, they face the obligation of doing their full share in placing the conduct of public affairs on a higher plane of performance. How can engineers best perform this obligation?

I am aware that this is an unusual time in the history of these movements. This is true of nations and of governmental agencies coming under them. And it is particularly true of professional, civic and trade groups.

On the eve of ascertaining the outcome of a development committee of one of the national engineering societies, and when

* Consulting Engineer, 170 Broadway, New York, N. Y.

coöperative efforts of engineers are taking shape in furtherance of a proposed National Department of Public Works, it is not fitting to attempt at this moment to be too positive as to remedial measures. But while we should not prejudge forthcoming recommendations it is necessary to create and maintain and strengthen a wide appreciation of the opportunities of engineers to play, at this particular period, a full part in a betterment program for the future. At a period when civilization is merging from its greatest upheaval and a new order of things is sought in various channels, it is the duty of engineers to prepare to act wisely and promptly in discharging their obligations during these stirring times.

I have not come with any radical views or novel remedies to put before you. It is doubtful whether it is wise at this particular moment to attempt to speak very positively on how best to proceed. Surely we should not attempt to draw final conclusions without having before us all the evidence of those investigators who have been diligently considering these matters for many months.

My purpose this evening will have been served if I succeed in refreshing your memories again as to the serious need of recognizing in the very early future the substantial obligations resting upon engineers, and in urging you on in your preparations.

This applies to us both as engineers and as citizens. Opportunities are now great. We must soon weigh available evidence as to methods of procedure and coöperate effectively in adopting those which seem best.

I propose to outline briefly a few views pertaining to some of the main topics engaging the attention of engineers. This is a period when it is not wise to devote ourselves too much to criticism of past and present conditions. Certainly our efforts should not stop there. We must take conditions as we find them and look them squarely in the face. The obligation rests on every engineer to study conditions and remedies and thus prepare himself to do his "bit" in the steps which should shortly be taken in the direction of progress.

Technical Aspects. — For over seventy years engineering organizations in the United States have been accumulating a

large fund of engineering knowledge which has been discussed and put on record for future use. It constitutes the greatest asset of our profession, and has played an important rôle in making progress along technical lines. For over twenty-five years I have been a member of the Boston Society of Civil Engineers, and I am always glad to record the substantial benefits which I have derived from the scientific information issued from this source. I hope that this will continue to be the case with this and other technical organizations. We must all remember that the coming generation is entitled to derive benefit from our experience as truly and fully as we have derived benefit from the technical papers and discussions of those who came before us.

I am one of those who believe that whatever betterments may come along other lines, technical organizations of engineers should not lose sight of the importance of continuing this element of their structure. This is one of the strong and not one of the weak points of engineering organizations. We should be careful not to lose our strength along technical lines as we plan for broadening our fields of activities.

Some engineers have been and always will be of greatest strength along technical lines. Such men should in the future be encouraged in their normal groove, and present engineering organizations seem to serve that purpose reasonably well.

I shall say no more on this topic beyond urging that we should not be hasty in giving up the good of present arrangements as we proceed in our endeavors to meet our obligations along lines of a non-technical nature.

Engineers need in particular to build up their strength along non-technical lines, both for the good of their country and of themselves. I take it that few if any engineers are so ultra-conservative or out of touch with modern affairs as not to agree to this proposition. In any event I shall endeavor to stress a few situations along welfare lines.

Human Aspects. — Engineers as a group of men have a very low coefficient of adaptability as they come in contact with other groups of men. The very nature of their technical point of view and their experience in earlier years seems to prevent many engineers from meeting other men in a fair spirit of compromise

in an effort to draw negotiable conclusions from all the information at hand.

Thus the engineer, as he comes in contact with the architect, lawyer, doctor or business man, has ordinarily very little facility in making judicious adjustments. Most human events of great importance are solved by conclusions drawn from premises that are established by more than one individual, and usually by more than one group of men. The engineer, convinced that his conclusions are sound from his premises, and that his premises in turn are the only correct ones, is frequently ignored by more experienced men of affairs. Thus the profession as a whole is belittled as a result of indecision or inability of many of its members to come to an agreement on the basic assumptions of a practical proposition. Engineering obviously deals with mathematics in some of its bearings, but as a group of men, engineers do not seem to appreciate the significance of fictitious accuracy. They have a tendency to make computations show an answer to the fourth decimal place when it is truly accurate only in the units or tenths place. Their education does not facilitate a broad, practical view of things.

In my opinion, one of the chief duties of the engineers as a group of men is to learn the lesson of judicious compromise and to recognize that all trained men are able to reach sound conclusions or premises. In the larger problems of human affairs, correct premises usually will be attained only by the concensus of opinion of several groups of interested men, and not by that of the engineer or any other single group.

No longer can the engineering profession afford to promote, either in their education or in their relation as citizens in after life, such a narrow technical viewpoint as in the past. They must become humanized. They should learn to recognize quickly the soundness of a great many practical, helpful suggestions in connection with their daily work, which come from contractors, architects, lawyers, bankers and business men, who are not technically as accomplished as they but who frequently are more far-seeing discerners of basic assumptions upon which a practical proposition should be founded.

The older engineers certainly face the responsibility of teach-

ing and leading younger members of the profession to bring about effective coöperation, which is imperative for advancement along several pressing lines. This must be done not only on an individual basis but on a wholesale scale which requires organization to that end.

Compensation of Engineers. — It appears that over 90 per cent. of the engineers in this country work on a salary. They are employees and not employers.

The high cost of living which has made such a profound impression on the affairs of our citizens during the past few years has distressingly affected many members of our profession. It is doubtless true that those connected with certain industries have been unusually prosperous during the past few years, but unfortunately this is not the situation with the great majority of engineers, particularly those on the pay roll of governmental agencies.

At a time when wage scales have been advanced for many groups of workers, in the effort to adjust incomes to increases in living costs, it is well for us to bear in mind that there are many engineers who for years have received no increase in compensation. It is my understanding that engineers in municipal service are unhappily situated in this respect to a greater degree perhaps than is found almost anywhere else. Excluding city or chief engineers and their first deputies and also departmental and divisional heads, the available data indicate that the average annual compensation of members of municipal engineering organizations in this country is about $1 830. Another significant fact is that these organizations which cover the complete personnel of engineering organizations in the cities making reports, with the exception of those coming under the four groups above stated, show an average age of thirty-nine years.

We also have to bear in mind that even more embarrassing circumstances surround some members of our profession, such as those as are now stated to be receiving as chief engineers of Southern drainage districts less than one hundred dollars per month by legislative enactment and who are wondering whether the compensation bonuses which they now receive will ever become a subject of investigation, with the result that they may

have to refund the difference between their legal salary and their actual compensation, which at best is scarcely above the rate of a fairly skilled laborer.

Civil Service requirements, classification lists and budget restrictions are some of the serious obstacles which are oppressing this group of men who, under unusual difficulties, are striving to perform a service which the public can illy afford to have neglected or performed inadequately.

One can scarcely refrain in this connection from thinking of the success attending the efforts of labor organizations and trade unions. Business men have developed their local organizations during the past few years, and have built up a central body through the United States Chamber of Commerce, with headquarters at Washington.

Even farmers, who are supposed to be the most conservative and individualistic class of citizens we have, are now organizing and arranging to have in Washington headquarters for a central organization. Why should not engineers organize effectively?

If the compensation factor were the only one, it seems clear that the older engineers have a distinct obligation here to render all the aid they possibly can to the younger man. This is something that can be done only by effective coöperation and through coördination of effort.

Civic Relations. — Engineers as a group stand solidly for good Americanism and good citizenship. Their chief characteristic is absolute honesty.

And yet they are strikingly indifferent as a group of citizens in their relation to public affairs. They seem to be so occupied with their own undertakings that they hold aloof to an astonishing degree from pressing questions of a governmental or community nature.

Engineers are said to represent somewhere from one third to one half of one per cent. of the voting strength of the country. As a group we are too small to cut much figure by ourselves, even if we were organized to work together effectively outside of technical lines.

This is a period of reorganization of state and various local governmental agencies coming thereunder. On many of these

questions the advice of engineers along broad lines will be helpful. It is gratifying to recognize that in some measure we are making progress in this direction. If we cannot perform as representatives of engineering organizations then we should affiliate with civic organizations, and preferably we should do both. Engineers should start at once to correct the public view which in some cases seems to be that engineers are of aid in public affairs in spite of rather than because of their technical training. Obviously, technical knowledge should be availed of in a practical way.

One of the humiliating things with which engineers have to contend is that in numerous cases, in carrying out engineering undertakings, non-technical administrators give little or no heed to the judgment of their engineering advisers. This is largely due to the fact that the engineers are unable by reason of education and habit of thought to impress the worth of their views on the other fellow. This is a situation by no means universal, but of sufficiently frequent occurrence to need most careful consideration.

Effort in Boston, New York and a number of other cities shows that engineers can accomplish a good deal if they will coöperate and build up the necessary team strength.

There are many factors with which to contend besides the traditional aloofness of the engineers. Among them, in regard to the salary question, is the continuity of service, which in some instances is supposed to depend upon responsiveness to the wishes of the non-technical administrative superiors. Things in this country are by no means on as sound a basis as in some of the European countries, where men of technical merit are not only listened to but continued in service regardless of the caprices of local politics, and ultimately are retired on a pension when old age comes upon them.

In this period of readjustment, engineers have an opportunity to make their position relatively more advantageous in the future than at present. In these days no man or group of men can stand still. We must go either forward or backward.

Welfare Organization. — It is in this channel that there is greatest need of coöperation and of coördination of effort by engineers.

This is necessary not only for the correction of poorly paid engineers, but in order that engineers as a group may function adequately on public affairs.

In the view of some, it is hopeless to anticipate that our national engineering organizations however successful they may be along technical lines, can possibly bring adequate support to the distinctly different but equally important proposition of advancing welfare work. Existing organizations, established for technical purposes only, cannot bring about the personal contact that is essential. Specialization in the broad engineering field has naturally brought classifications of societies and of men. Civil engineers and electrical engineers are not interested in the same technical subjects and are not well acquainted with each other.

But for welfare work special fields cannot be recognized. Differences must be put and kept aside and, therefore, the character of the organizations of the technical societies must be preserved and welfare facilities built up from the bottom. We must organize on lines of common interest and common need.

Local units for local problems are essential. We must find a way to bring about unification and solidarity among engineers if success is to attend welfare efforts. To do this it is necessary to overcome the apathy and inertia of the great majority of the members of the profession.

At the moment we must wait the outcome of our development committees. But we should not consume one day needlessly in preparing our program for procedure.

In this connection we must not overlook the American Association of Engineers. I understand that this organization is growing by leaps and bounds, adding perhaps one thousand new members per month. It is growing in strength particularly in the West. What its future may be I do not know, but I take it that it is striking a sympathetic chord among the members of this profession who are most determined to better existing conditions.

If this new organization is well managed and asserts its intention not to compete with technical organizations on technical work it seems obvious that we have more than the beginnings

of a welfare organization on a sound basis. This movement seems bound to come up for immediate comparison with the efforts that can be made by technical organizations in doing good work in welfare matters. What is needed is quick action.

Young Men Leaders. — There is an old saying that old men are needed for counsel and young men for action.

In welfare matters there is a great handicap in the engineering field through a general limitation of acquaintance of older and younger men, who do not seem to know each other well enough to enlist sympathetic and mutually responsive action.

Many older men seem to be set in technical and executive grooves, and are so thoroughly occupied that they are not inclined to coöperate very much with younger men. This should be corrected.

I believe that young leaders should be selected, instructed, advised and strengthened so far as practicable, so as to serve as leaders of the large numbers of young men in the engineering profession. This suggestion involves initiative upon the part of the younger men themselves. If they will but come forward with definite schemes for betterment and with men to properly present them, they will be accorded very sympathetic hearing by the older men.

This should give contact which is sadly needed now not so much for technical as for welfare work. However, such contact would prove helpful in my opinion in every way. Leaders cannot be made over night. Hard work is required to study out the situation, and it is important to get action without delay.

Construction Division of the Army. — You have all heard a good deal about the work of the Construction Division of the Army in performing emergency work in this country incident to the Great War. I mention it to-night not with the view of going into details but in order to use it as an illustration of what civil engineers and contractors can do along organization lines when they are sufficiently energized. This division brought together with astonishing speed for the aid of the Government the best practice in civil life. It established some new principles for the conduct of government affairs. In fact, as an organization that did about one billion dollars' worth of work in eighteen

months, it is very instructive to study its organization chart. The men having that organization in hand are entitled to credit for establishing some sound principles as applied to the management of large affairs. They proceeded on the following bases:

1. No man in immediate charge of work is given responsibility beyond what may be reasonably expected as regards the range of types of tasks which one man can look after with the aid of proper assistants; and the same is true as to magnitude of work.

2. The organization is such that the man in final authority in charge of policy, finances, labor, materials and other controlling items can be reached without delay by the man in charge of any enterprise.

Adherence to these fundamental aspects of efficient organization for large enterprises avoids the delays incident, on the one hand, to pigeonholing by superiors, and on the other hand to the non-functioning of subordinates who have neither jurisdiction themselves nor access to those who are so equipped.

Decentralization was one of the outstanding features of the performance of the Construction Division, which it should be made plain was essentially a young man's organization.

Further, the efforts of this group of war workers showed strikingly what immense advantages accrue through adequate direction of effort.

It is not necessary to dwell here on the future of this division or the outcome, in the army reorganization bill now being formulated in Congress, with respect to the perpetuation of the methods built up by this division. Whatever the outcome, I wish to make it plain that in my judgment there is no reason for the comment sometimes heard that the continuance of this division is in support of some of its original personnel. I feel strongly that it is the methods and not the personnel of the division that it is important to secure for the future advantage of the Government.

Furthermore, as to personnel, that has disappeared to a very substantial degree, and the question of the future deals with the ability to retain within the organization sufficient men of adequate experience rather than with the fear that it may become a bureau saturated with the normal characteristics of governmental bureaucracy.

Let me urge you to keep clearly in mind this striking example of what civilian engineers and contractors can do by way of organization and joint action when sufficiently aroused. This is one of the hopeful features in connection with the question of success attending present opportunities for engineers to organize along better lines.

National Department of Public Works. — This subject is known well to you, I am sure. For two generations civil engineers have sought to get the engineering work of our national government conducted on better lines than at present. Without a doubt it is a move in the right direction and should be adopted.

This is an unusual period, and this particular movement for a National Department of Public Works offers one of the several well-defined propositions on which engineers may progress in building up their strength throughout the country in a coöperative and coördinated way for real action.

It is gratifying to learn that matters in this respect are moving so well in this district.

In the early future matters should be speeded up on this proposition, and finances arranged so as to meet the expenses of making an adequate preparation for supporting the Jones-Reavis bill in Congress.

A few months ago it was thought that serious opposition would be encountered from the Engineer Corps of the army. But it appears that this will not be insurmountable by any means. Indeed, it is believed by many that 90 per cent. of the Engineer Corps would welcome a departure from its earlier traditions. The corps will probably have its hands full on military matters, and undoubtedly would profit from more intimate contact with civilian engineers and the methods of the latter. Coöperation between the army and civilian engineers should prove of benefit from all angles, and should be brought about in an effective way as promptly as practicable.

As to Organization Needs. — There are two phases of our needs as to organization of engineers. One relates to reaching and interesting the younger and less technically accomplished men in this line of work. The other involves the coördination and guidance of concerted action.

Our present Engineering Council has taken important steps recently, but seems to be more loosely attached to the underlying units or groups than is desirable. All of us await with interest the outcome of the Conference Committees on Development on behalf of the National Societies.

In reaching the less conspicuous workers in our lines, and in making all men of high or low attainments keep in step and move solidly in the right direction, we would do well to note how the architects have been proceeding. In New York State is a new association where heads of large firms join with draftsmen in their employ provided they are over twenty-one years of age. In its bulletin it states:

> "If architecture is to take its rightful place in the upbuilding of the new world, there must be joined in one effort all those who are engaged in architectural work — whether as employers or employees, beginners or experts. The whole group of architects and those who are to be the architects of the future must move forward together."

It is up to the engineers to decide promptly how best to effect needed solidarity among all of its workers.

MEMOIR OF DECEASED MEMBER.

FRED EUGENE SAUER, JR.*

Fred Eugene Sauer, Jr., son of Fred E. Sauer, of Salem, Mass., and Lillian Z. (Taylor) Sauer, of Marlboro, Mass., was born at Everett, Mass., April 3, 1893, and died in Melrose, Mass., January 30, 1919.

Mr. Sauer received his early education in Everett, graduating from the high school in 1910. He then entered the Massachusetts Institute of Technology, and graduated from the civil engineering course in 1914, with the degree of bachelor of science.

During the early summer of 1914 he served as rodman with the N. Y., N. H. & H. R. R. at Providence, R. I. He then entered the service of the Public Service Commission of New York in August, 1914, as assistant engineer on subway construction, being largely concerned with matters of design and estimates. He left the work of the Commission in February, 1916, and joined the organization of Post & McCord, New York City, as a structural draftsman, which employment continued until August, 1916.

Mr. Sauer's next residence was in Washington, D. C., where he was employed as structural draftsman in the office of the Bureau of Yards and Docks of the Navy Department for the period from August, 1916, to November, 1917. His work involved studies in connection with some of the naval developments of that period, which added to the interest as well as to the breadth of his experience.

In November, 1917, Mr. Sauer left the Navy Department, and came to Boston to join the staff of Metcalf & Eddy, which connection continued until his death. His work as assistant engineer on design, with this firm, involved a variety of problems requiring careful study and the exercise of ingenuity. This seemed to appeal to him especially, and as he was ambitious, as

* Memoir prepared by Frank A. Marston.

well as studious by nature, he established an excellent record for service.

He was a member of the Boston Society of Civil Engineers, and actively interested in general engineering work, particularly methods of construction involving unusual difficulties.

During the late fall of 1918, Mr. Sauer, acting for himself, supervised the raising of two lines of 24-in. water main about seven feet for the Boston & Lockport Block Company. These pipes, the property of the Metropolitan Water and Sewerage Board, crossed land of the company which it was proposed to develop, thereby necessitating the raising of the pipes, subject to the inspection and approval of the engineers of the board. This work was carried on to successful completion, in spite of numerous difficulties, not the least of which was labor trouble. In this work he took a great interest, and spent long hours, at times under considerable strain, which latter fact may perhaps account partly for the suddenness with which he succumbed to an attack of pneumonia, which with influenza was raging at the time. It is a strange coincidence that an article written by him, on the above work, was published in *Engineering News-Record* of January 30, 1919, the day of his death.

Mr. Sauer was married in 1913, to Doris C. Sparrell, of Everett. He was one who evidently appreciated his home and family, as he often spoke of them in conversation with his associates. He had three daughters, — Cynthia Sparrell, Dorothy Neale, and Betty Frances. His companionable nature gained him many friends, by whom his loss is keenly felt.